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The Monthly Magazine of Engineering and Production in the Manufacture of Metal Products

SHOP PRACTICE

Abrasive-Belt Finishing ... *By W. A. Papworth* 141
Determining Torque in Tapping ... *By A. J. Carruthers* 149
Welding in an Aircraft-Engine Plant ... *By George H. DeGroat* 153
Machining Automotive Transmission Cases on Transfer-matics ... 160
Rapid Milling of Cam Paths in Gun-Bolt Sleeves ... 166
Preparing Shafts for Metallizing ... *By John E. Wakefield* 174
Tooling Equipment Used in Making the Hercules Engine *By Robert Mawson* 178
Cemented Carbides Used for Non-Cutting Applications *By J. S. Gillespie* 184
Typical Heat-Treatments for Aluminum Castings (Data Sheet) ... 239

MACHINE AND TOOL DESIGN

Special Molds for Plastic Parts ... *By John J. Johnescu* 169
Surface Fatigue Life Increased by Crowning ... *By R. Howard* 181
Roll-Actuated Clamping Device ... 189
Intermittent Reversing Rotary Motion Produced by Rack Mechanism ... *By F. Server* 190
Tailstock Attachment for Supporting Lathe Work without Centers *By Robert Mawson* 191
Automatic Clamp Facilitates Loading and Unloading of Press *By Cliff Bossmann* 192
Simplified Method of Laying out Progressive Dies *By Federico Strasser* 192
Anti-Friction Support for Simple Indexing Fixture *By Roger Isetts* 193
Simple Method of Holding Shaper Tools Reduces Breakage *By Stanley R. Welling* 194

MANAGEMENT PROBLEMS

What the Taft-Hartley Act Has Cost Labor ... *By Charles O. Herb* 157
Computing Return on Invested Capital ... 196
The Sales Engineer and His Problems ... *By Bernard Lester* 201

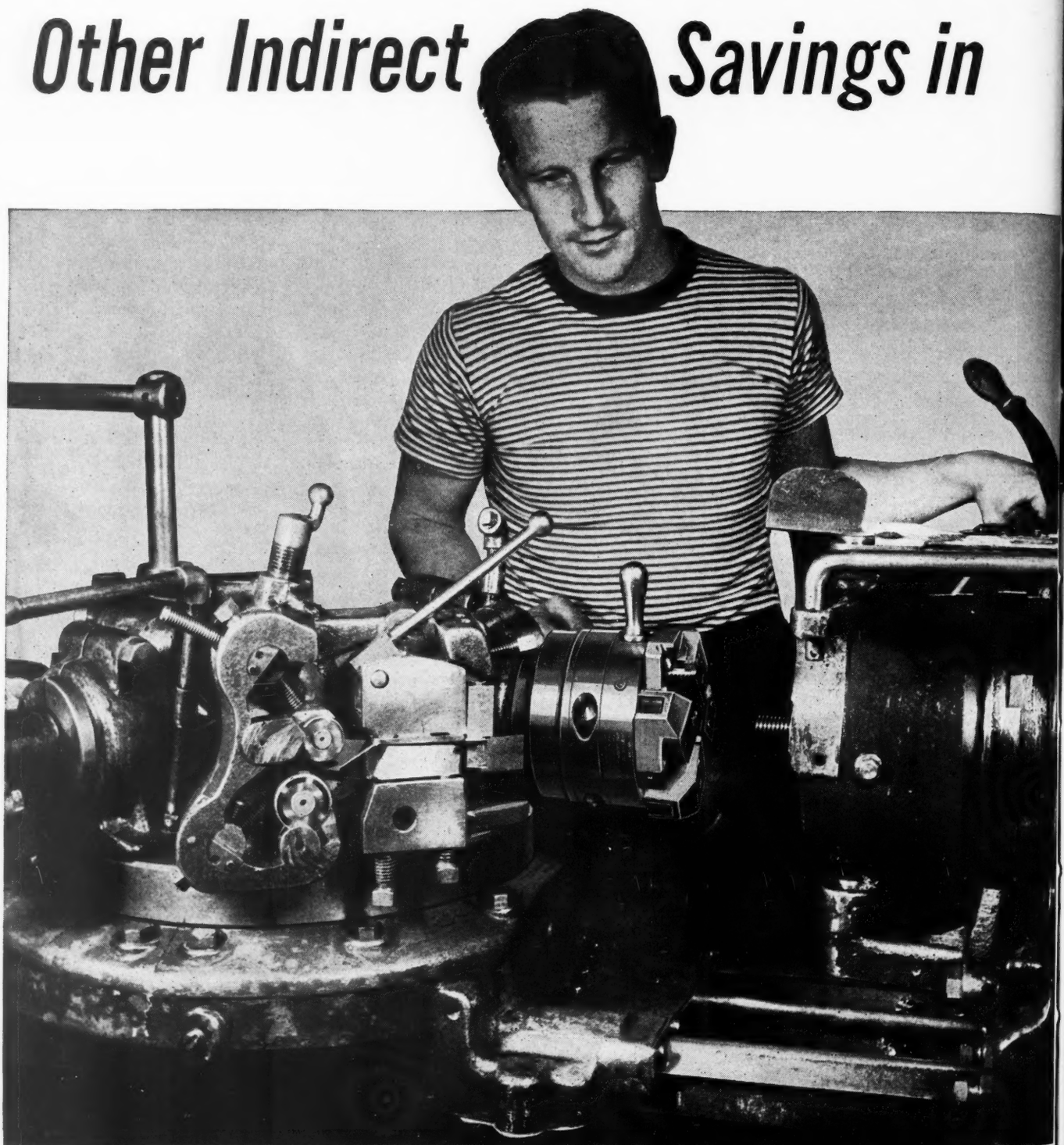
DEPARTMENTS

Engineering News ... 172
Materials of Industry ... 186
Ingenious Mechanisms ... 189
Tool Engineering Ideas ... 191
Questions and Answers ... 195
The Sales Engineer ... 201
Shop Equipment News ... 203
New Trade Literature ... 228
Between Grinds ... 235
News of the Industry ... 236
Data Sheet ... 239

Product Index 325-364
Advertisers Index 367-368

NOW . . . . . 36 PIECES

Other Indirect Savings in



WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF THREAD

MACHINERY
Vol. 56 FEBRUARY, 1950 No. 6

Abrasive-Belt Finishing

By W. A. PAPWORTH, Staff Engineer
Porter-Cable Machine Co.
Syracuse, N. Y.

ABRASIVE-BELT grinding is a relatively old method of finishing, originally developed for use in the woodworking industry. Since the early machines and abrasive belts were not suitable for use with a coolant, excessive heating and rapid loading of the belt occurred. With the introduction of plastic-bonded cloth belts having electrostatically applied abrasive and the development of improved machines that permit grinding with a coolant, the application of the process has rapidly expanded to the finishing of many different kinds of materials in a wide range of industries.

Tremendous strides were made during World War II in applying abrasive-belt machines for the low-cost, rapid finishing of flat and irregular-shaped surfaces. The difficult job for grinding the edges of armor plate was accomplished by this method. In steel mills, abrasive belts were used in polishing stainless-steel sheets. Today, aluminum, brass, copper, lead, cast iron, steel, glass, ceramics, and plastics are among the materials being ground and polished by this method. Many of the present-day belt grinding applications are specific production operations, while others are in tool-room, machine-shop, assembly-department, stock-room, and welding and maintenance work.

A major advantage of abrasive-belt grinding is the time saved and the high production obtained. Rapid stock removal is possible on metal, plastic, glass, or even carbide parts. However, where the amount and resistance of the material to be removed are such as to require the use of considerable abrasive, the cost of the abrasive must be considered. Thinly coated belts provide less abrasive per dollar than a solid grinding wheel, but rapidity of grinding may offset this.

Abrasive-belt grinding machines fall into three general classifications—platen, contact-roll, or free-belt grinding. Any of these three types of machines can be used with or without coolant, for wet or dry grinding.

Application of Platen Grinding

In abrasive-belt platen grinding, the work is ground on a straight section of the belt, which is supported by a platen or backing plate, as seen in Fig. 1. The advantage of this type of grinding is that a large area of the work can be finished at one time.

Dry platen grinding is the oldest method of abrasive-belt machining, and was originally employed only for wood sanding. It is still useful for grinding thermosetting plastic parts and zinc die-castings, as well as for light operations on iron castings. Major objections to this type of grinding are heating of the work and platen, loading of the belt, and large amount of dust produced.

To overcome these objections and increase the application of this method of grinding, abrasive-belt machines have been improved and plastic-bonded belts developed to permit grinding with a coolant. Wet platen grinding is now a widely used and important branch of abrasive-belt machining. It is especially adaptable to work requiring flatness or close dimensional accuracy, and is capable of high production rates at low cost for many classes of work.

Non-ferrous materials are readily surfaced by wet platen grinding, since such materials do not tend to stick to the wet belt and load it, as is the case in dry platen grinding. Deeper cuts involving the removal of a greater volume of material can be taken more economically than with dry grinding, but shallow depths of cut are preferable. Materials adapted to wet platen grinding, in the approximate order of their suitability, are plastics, aluminum, brass, bronze, steel, and cast iron.

The lighter the cut, the greater the area that can be finished on abrasive-belt machines. Maximum stock removal for economical production is generally considered to be about 1/16 inch on non-ferrous materials and 1/32 inch on ferrous materials. The area to be finished should seldom exceed approximately 30 square inches on soft metals, and half as much on iron or steel, even when very little stock is to be removed. By designing the part with bosses to give an interrupted surface, much larger parts can be handled, since the area to be ground is reduced.

Multiple loading, to permit grinding several pieces simultaneously, is a desirable practice in wet platen grinding. The work-pieces should be staggered or arranged obliquely, in order to make use of as much belt width as possible, and to permit the coolant to reach the work.

Abrasive-belt machining with a resilient or padded platen, and the use of coolant, is suitable for grinding irregular-shaped pieces made from plastic or soft metal, including the inside surfaces of hook-like pieces. It is particularly adaptable for blending different surfaces and for blending ground surfaces with unground portions of the work. Resilient platens are also useful in cases where surfaces that are not quite flat must be finished, and where it is important that the entire surface be reached by the abrasive.

Fig. 1. Abrasive-belt platen grinding, in which the work is ground on a straight section of the belt. The belt is supported from behind by a platen

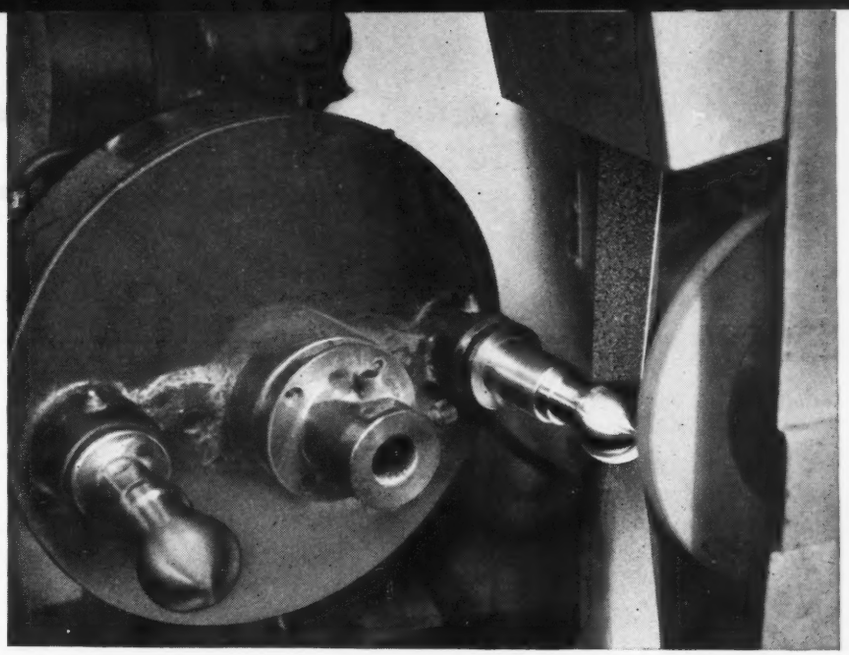


Fig. 2. Ball-shaped crank-handles are finish-ground by an abrasive belt that is formed to the desired contour by a contact roll behind the belt

In wet resilient-platen grinding, the platen is usually formed to suit the work, and padded with felt or sponge rubber, which, in turn, is covered with graphite-asbestos, waterproof beaded cloth, or leather. The life of any of these coverings can be lengthened by coating them with graphite and shellac.

With a resilient platen covering, a grease-kerosene treatment of the abrasive belt to prevent loading, and omission of the coolant, flat pieces that have been ground in previous operations can be polished. A graphite-asbestos covering over a hard platen preserves some of the polishing effect in wet-belt grinding, involves only a minor sacrifice of flatness, and, in some cases, increases the belt life. Polishing of previously ground parts and the blending of irregularly curved surfaces before buffing are generally accomplished with fine greased abrasive belts of 180 or 220 grain size. Kerosene is applied to the belts with a rolled cloth dauber to avoid loading.

Recommendations for Contact-Roll Grinding

The contact-roll method of grinding is performed by the abrasive belt passing around a pulley or contact roll, either with or without coolant. In wet contact-roll grinding, plastic-bonded abrasive belts are employed with coolant and lubricant to keep the belt sharp, minimize loading, and prevent burning. High rates of stock removal are possible, and a long belt life is generally obtained.

Wet contact-roll grinding is particularly suitable for removing parting lines and fins from brass, aluminum, and iron castings, and steel forgings, as well as for rough-grinding such parts preparatory to machining.

Since a platen is not used with this method, approximate flatness can be obtained only by skillful manipulation of the work against the wheel. Difficulties are sometimes encountered in rounding or "dubbing" the ends of the work, which platen grinding avoids.

The smaller and harder the contact wheel, the narrower the band of contact will be between the abrasive belt and the work-pieces. With this narrow contact area, higher belt speeds are permissible and greater pressure can be exerted on the work in dry grinding without loading the belt or burning the work.

Many different types of contact wheels are available, the selection depending upon the specific application and the hardness or softness of wheel required. Canvas wheels cannot be used with a coolant, but rubber-covered contact wheels are suitable for wet grinding.

General recommendations for the belt speeds to be used in contact-roll polishing are given in the following:

Material to be Polished	Belt Speed (Surface feet per min.)
Soft metals (aluminum, brass)	7500
Forged steel tools	7000
Cast iron and mild steel	6500
Alloy and stainless steel	4500

If the belt glazes and dulls quickly at the recommended speed, a slower speed, a softer contact roll, a segmented contact roll, or the use of silicon-carbide abrasive (as in the case of cast iron) may prove beneficial.

When an abrasive belt is traveling around a

wheel, it cannot readily be bent laterally across the wheel. Light-weight abrasive belts running over a soft wheel at low speeds can be flexed to grind irregular surfaces, as shown in Fig. 2. Such double flexure, however, is rather hard on the belt fabric and is not recommended for heavy-duty work.

An effective arrangement for heavy-duty or high-production grinding of this type is to place a formed contact roll or intermediate idler behind a straight section of the belt. The roll forms the belt to the desired contour without buckling or damage, and permits the use of a firm roll, accurately shaped to the contour of the work.

When the shape of the contour is especially sharp, it may be necessary to flex the belt manually before it is used. Belts that operate over a formed roll should be no wider than necessary.

Free-Belt Grinding of Irregular Contours

Free-belt grinding is employed for parts having exceptionally irregular contours. With this method, neither a platen nor a contact roll is utilized, the operator frequently using his fingers (protected by tape) behind the abrasive belt to twist it and follow the contour of the part. This type of operation has been used for a long time in the furniture and woodworking trades for sanding rounded, irregular, and obstructed surfaces with garnet cloth. It is used today in plastic and metal grinding and polishing of surfaces having irregular curves, Fig. 3, and surfaces that cannot be reached by a belt in any other way.

An application of wet free-belt grinding is the rounding or "pencilling" of the edges of glass. On a standard abrasive-belt machine, free-belt grinding can be done just below the platen, above the contact rolls, or in a groove cut across the platen. The wet free-belt method is also used for the rough- and semi-finish-grinding of obstructed and rounded surfaces on brass, aluminum, or plastic parts, and for removing irregular parting lines on molded plastic parts.

Selection of Abrasive Belts

Many variables are involved in the selection of abrasive belts for specific applications. The following recommendations are general, and modifications will, of course, have to be made to suit the job. Aluminum-oxide abrasive belts are usually employed for the platen grinding of steel and high tensile-strength bronze, while silicon-carbide abrasive belts are used for grinding practically every other material. In dry contact-roll grinding, glue-bonded aluminum-oxide abrasive belts are generally employed on all materials for roughing and intermediate operations. Silicon-carbide abrasive, however, is used prior to buffing in polishing operations. The grain size of the abrasive depends upon the roughness of the surface to be ground, the depth of cut, and the degree of smoothness desired.

General recommendations for the belt speed, abrasive, grain size, and pressure to be used on various materials are given in the accompanying table. More pressure is required with aluminum-

Fig. 3. In free-belt grinding of parts having exceptionally irregular contours, no platen or contact roll is provided behind the abrasive belt

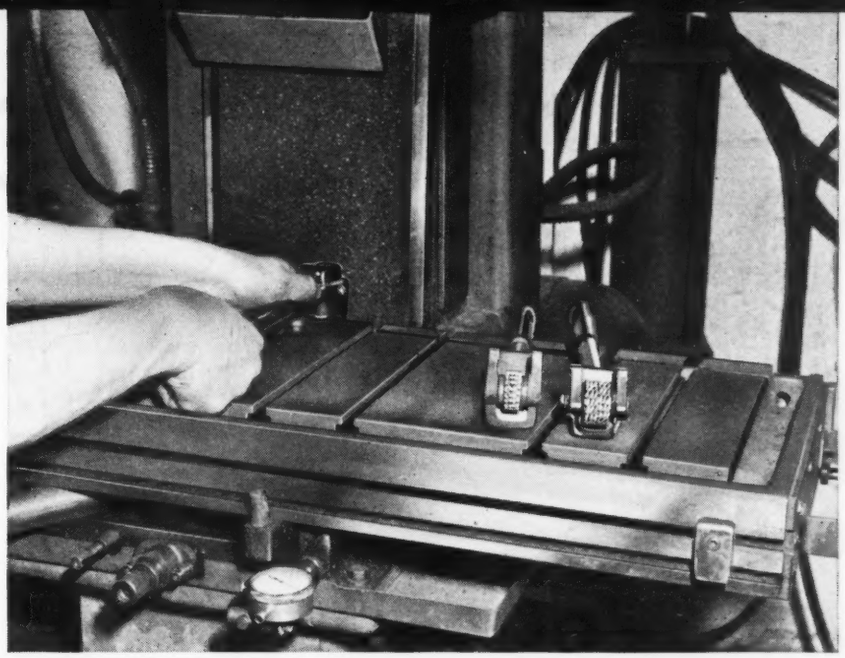


Fig. 4. A blunt, partially worn, wheel type dresser, either star-wheel or corrugated, should be used periodically to resharpen abrasive belts

oxide belts than with silicon-carbide belts. When the work is applied to the belt by hand pressure, and it is impossible or burdensome to apply sufficient pressure, a change from aluminum-oxide to silicon-carbide abrasive and a coarser grain size may be helpful. In grinding flat surfaces, it is generally better to rough-grind to within 0.003 inch of the desired size with a coarse abrasive belt and then finish with a fine-grain belt.

A major requirement in belt grinding over a platen is that enough pressure be exerted to make the belt cut properly. On all but the softest materials, a low belt speed and adequate pressure will generally give better results than high speeds and low pressures. Too high a belt speed and too little pressure tend to heat the work and glaze the abrasive. On the other hand, too low a speed and too much pressure tend to fracture the abrasive and dislodge it from the belt. Belt speeds for platen grinding are generally lower than those that are employed for contact-roll grinding.

Periodic dressing of the abrasive belt will counteract glazing. A blunt, partially worn wheel type dresser (of either the star-wheel or corrugated form), Fig. 4, should be used to resharpen the belt. The coarser the belt, the more the belt life can be prolonged by dressing. The life of

Belt Selection and Operating Conditions Recommended for Wet Belt Grinding over a Platen

Material to be Ground	Abrasive	Grain Size		Belt Speed, Surface Feet per Minute	Pressure of Work against Belt	Coolant
		Roughing	Finishing			
Aluminum and Brass	Silicon Carbide	36 to 80	120 to 180	4600 to 5000	Light	Soluble Oil in Water (40 to 1)
Copper and Lead	Silicon Carbide	60 to 80	120 to 180	2550	Very Light	Soluble Oil in Water (40 to 1)
Cast Iron	Silicon Carbide	24 to 36	60 to 80	2550 to 3550	8 pounds per square inch (New Belt) 25 pounds per square inch (Old Belt)	Plain Water
Soft Steel	Aluminum Oxide	36 to 60	120 to 180	3550	8 pounds per square inch (New Belt) 25 pounds per square inch (Old Belt)	Soluble Oil in Water (30 to 1)
Hard Steel	Aluminum Oxide	50 to 80	180 or Finer	2550 to 3550	Heavy	Soluble Oil in Water (30 to 1)
Glass and Ceramics	Silicon Carbide	36 to 80	180 to 320	2550 to 3550	Light	Plain Water
Plastics	Silicon Carbide	80 to 120	320	2550 to 3550	Light	Plain Water

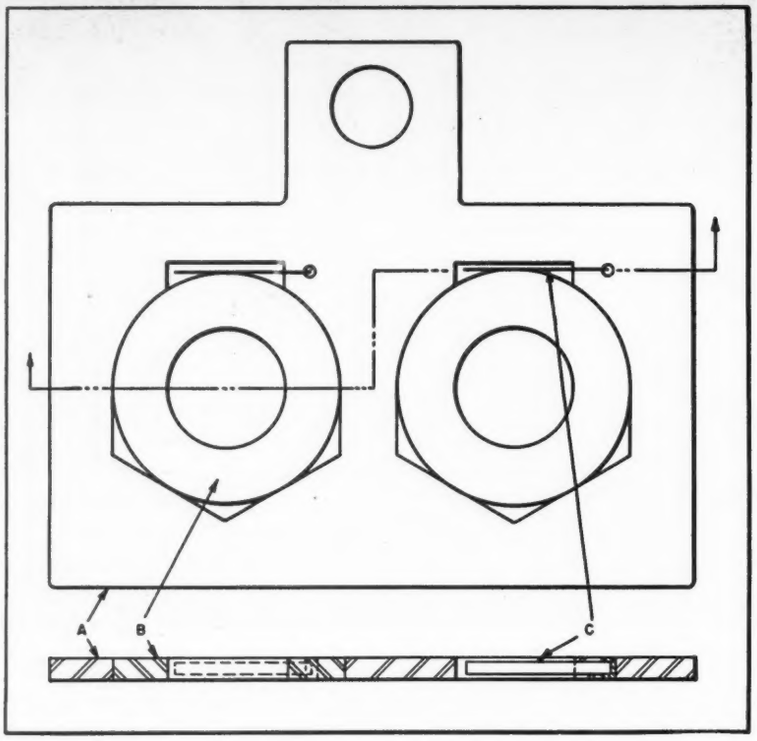


Fig. 5. Turn-over fixture employed to hold small cylindrical parts, such as washers seen at (B), while grinding both sides on an abrasive-belt machine

silicon-carbide abrasive can be increased more by dressing than that of aluminum oxide.

Abrasive-belt ends may be joined by a diagonal lap or they may be butt-jointed. Occasionally, in using a diagonally lapped belt, more stock may be ground from the upper right corner of the work (looking toward the belt), or the right end of a cylindrical surface. This condition may be due to uneven thickness of the belt, the thickness of the belt over the joint sometimes being greater than the thickness of the joint.

The quantity of coolant that actually reaches the grinding area is an important factor in the relation between the belt speed, pressure, and size of machine (power) used. Unlike cutting with an abrasive wheel or cutting tool, the grinding area in abrasive-belt machining is large. Very little of the heat generated by grinding is removed by conduction. Flooding of the work is desirable, but most of the cooling is done by the coolant that is carried to the actual grinding area. A trough can sometimes be provided on the fixture to funnel coolant directly to the grinding area and thus minimize loss of coolant by splashing.

For grinding glass, ceramics, and plastics, plain water is used as a coolant. It is frequently flushed away without recirculation because some kinds of plastics, for example, cannot be filtered out of the water satisfactorily. A copious flow of coolant is desirable, especially on glass.

For cast iron, water with tri-sodium phosphate is recommended—about 1 ounce to the gallon. To prevent rusting, 1 ounce of nitrite of soda may be added to 40 gallons of water.

Soluble oil mixtures are employed for grinding

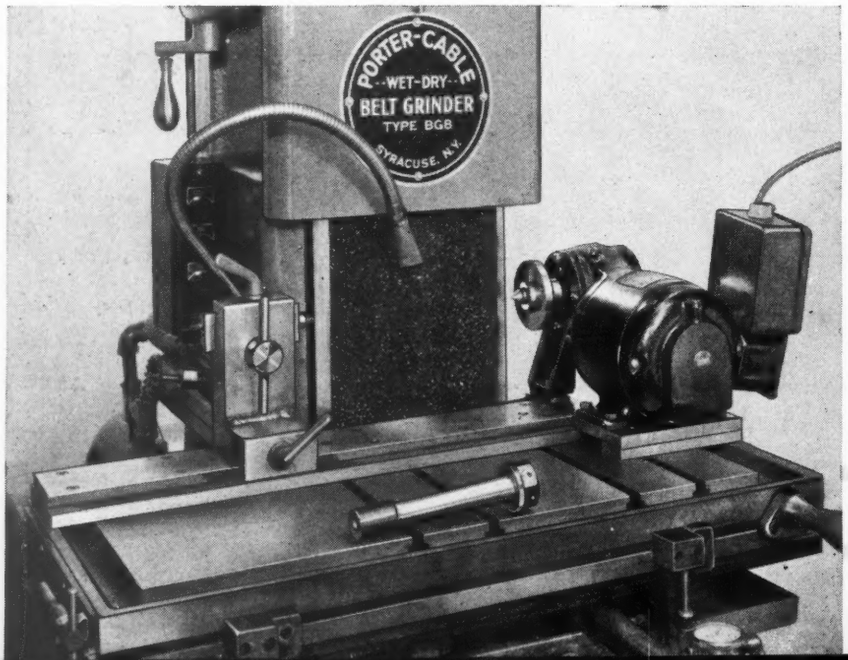


Fig. 6. Cylindrical sections of parts can be ground on an abrasive-belt machine by means of a motor-driven fixture equipped with centers for rotating the work

most other materials. The proportion of water to oil depends upon the manufacturer's recommendation for the specific compound, and upon the nature of the work. For example, in grinding brass and copper, the mixture may be 80 parts of water to 1 part of soluble oil; for aluminum and soft steel, 40 to 1; and for stainless and hardened steels, 20 to 1. Less oil promotes rapidity of cutting, while more oil improves the surface finish of the work and reduces the heat generated.

Soluble oil or a water-base coolant should never be used in grinding magnesium. A light grinding oil or kerosene is recommended for such operations. Magnesium chips should be removed from the machine frequently. Iron or steel parts should not be ground on a machine containing magnesium chips.

Grinding oil or kerosene can also be used as a coolant on plastics or in other cases where water is prohibited. Light grinding oil sometimes produces a better surface finish on aluminum than soluble oil.

Some Points to be Observed in Grinding

Whenever possible, the work should be arranged with its longest dimension across the belt. In this way, a greater width of belt, carrying more coolant, is employed, and faster, cooler grinding is possible. The part should be arranged to minimize the distance that the belt must carry the hot chips over the work.

Hollow rectangular parts and similar shaped pieces should be held at an angle to the direction of belt travel, so as to equalize the distance the belt travels over different portions of the work. Parts containing bosses should be similarly tipped, so that one boss is not directly over another. In multiple loading, the parts should be staggered or arranged obliquely to facilitate cooling. Rapid oscillation of the parts minimizes heating and prevents burning of the work. To obtain maximum accuracy or flatness, a short fast oscillation is preferable to a longer and slower one.

When a concave surface is produced, it is sometimes due to expansion caused by heating during grinding and subsequent uneven contraction during cooling. Supporting of the work at the center instead of at the edges, resulting in distortion during grinding, is another reason for the formation of concave surfaces.

Factors that prevent obtaining a high degree of flatness on the part are insufficient belt tension, a worn platen, excessive belt speed, insufficient cooling, uneven pressure on different portions of the work, insecure mounting of the work, too long a grinding cycle, and the removal of too much stock with too fine a belt or possibly with an unevenly worn belt.

Adequate tension must be maintained on the abrasive belt while grinding to prevent the work from tearing the belt. When the machine is stopped and the coolant turned off, belt tension should be released to prevent the belt from breaking due to shrinkage.

Many advantages can be gained by designing the part purposely for abrasive-belt machining. Surfaces that are to be belt-ground should be recessed whenever possible. Often the total area to be ground can be reduced from 50 to 75 per cent in this way. Thus, grinding time is reduced, belt life lengthened, and the weight of the casting decreased.

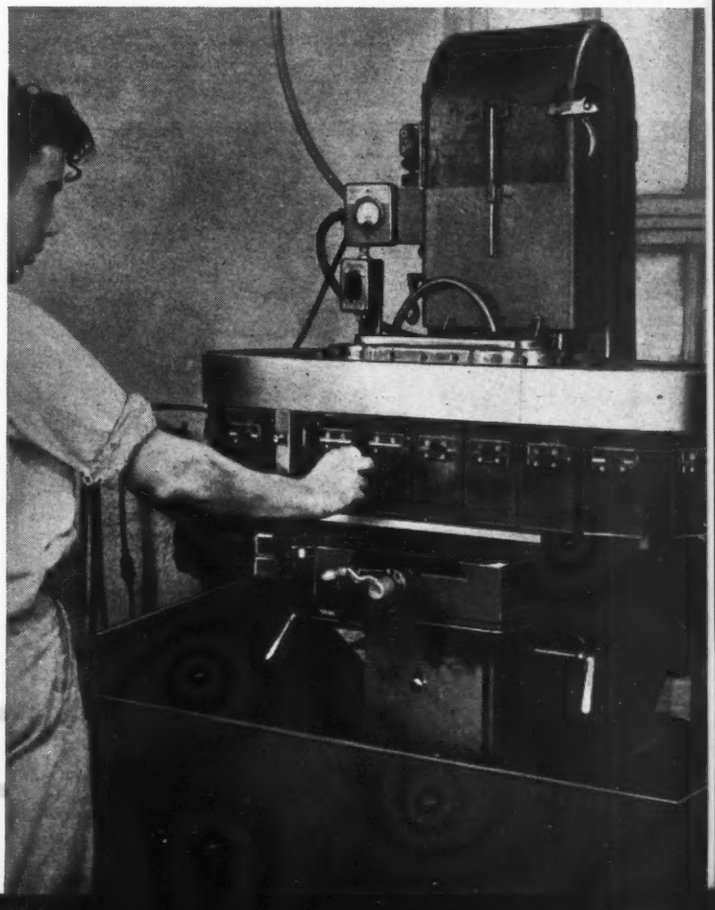


Fig. 7. An automatic work-handling fixture provided with twenty-one chain-driven work-carriers enables from 1000 to 3000 parts to be produced per hour

Design of Work-Holding Fixtures

Relatively simple and low-cost work-holding fixtures can often be used on abrasive-belt machines. As the pressure of the belt is constantly downward, over the whole grinding area, and outward toward the fixture, light holding devices are generally sufficient. It is always desirable to support the work as close to the belt as possible. Since most belt grinding operations are fast (seldom requiring more than thirty seconds per part), provision for quick loading and unloading is an essential requirement of the fixture design.

It is frequently advantageous to provide a slightly resilient covering, such as a thin layer of firm rubber packing, on the work-supporting surfaces of the fixture. Burrs or other raised surfaces on the part will sink into a covering of this kind, and the location of the work will not be affected. Such a covering also provides uniform support behind the work, and is favorable to long belt life.

When large quantities of small cylindrical parts, as, for example, the washers *B*, Fig. 5, are to be ground on both ends or sides, they can be loaded into through holes in the plate or "paddle" *A* of a turn-over fixture. The loaded paddle is placed against an angle-plate or back-stop during grinding. When the washers have been ground on one side, the position of the paddle is reversed and the opposite side is ground to a finish stop. If the parts are thin, a flat spring *C* can be fastened to one side of each hole in the paddle to hold the work.

Maximum precision is obtained with this type of fixture when only two parts, spaced to an over-all width of about 6 inches, are ground at once. With small parts, or when less accuracy is necessary, two or more rows of parts can be ground at once. In such cases, the parts in alternate rows should be staggered in order to make full use of the belt width, permit coolant to reach all of the parts, and avoid overheating.

The motor-driven fixture seen in Fig. 6 is mounted on the table of an abrasive-belt machine for grinding parts of cylindrical cross-section. The part is rotated between centers and fed in to the belt. In some cases, the work is oscillated slightly.

For mass-production applications, automatic work-handling fixtures such as the one illustrated in Fig. 7 are suitable. This chain-driven fixture has twenty-one work-carriers. As each carrier passes across the belt, it is automatically fed toward the belt and then retracted. A production of from 1000 to 3000 parts per hour is obtained with this device. Vacuum type fixtures are useful for holding some kinds of work.

Work ranging from 3/32 inch to 2 1/4 inches in diameter can be handled in one fixture on the centerless belt grinder seen in Fig. 8. The endless abrasive belt operates over a resilient contact roll which eliminates chatter and produces a smooth finish. The regulating wheel controls both the speed and feed of the work.

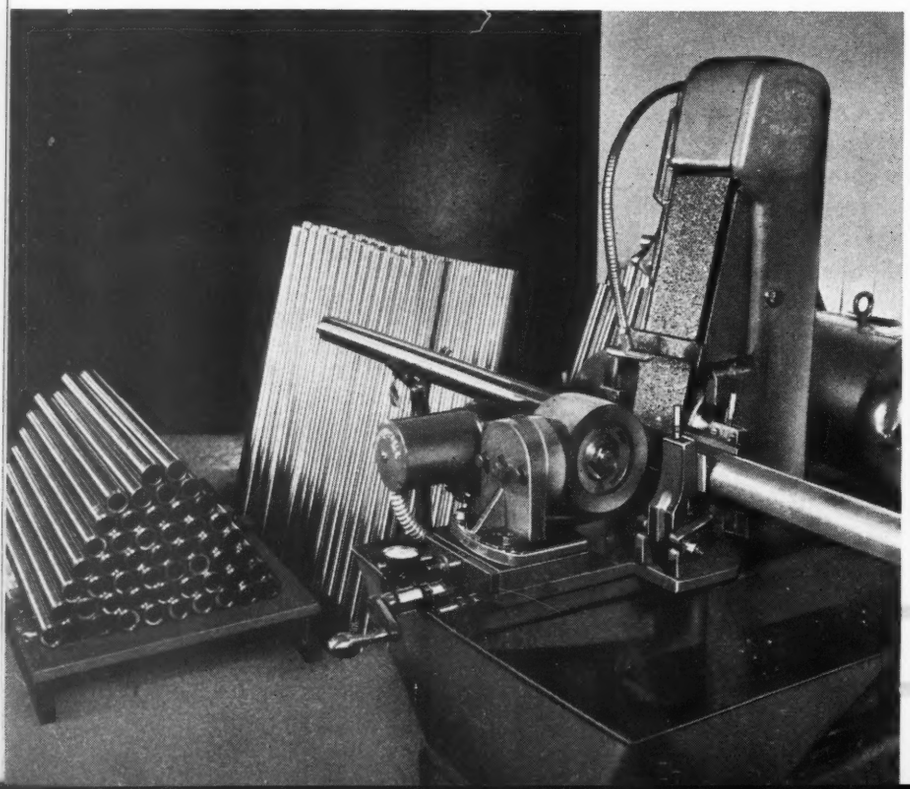


Fig. 8. Centerless belt grinder on which work ranging from 3/32 inch to 2 1/4 inches in diameter can be ground without changing fixtures

Determining Torque in Tapping

A Method by Means of which Tapping Torque Can be Sensitively Measured and Recorded

By A. J. CARRUTHERS, Research Engineer
Greenfield Tap & Die Corporation
Greenfield, Mass.

THERE is a definite relationship between the cutting efficiency of a tap and the twisting effort required to turn it. The amount of this effort depends upon many variable factors, which include design of tap, speed, material being tapped, lubricants, and operating conditions. In order to improve the design of taps and to provide users with specific information on the most efficient tapping methods, a means of measuring the individual effects of these effort consuming factors is needed.

The Greenfield Tap & Die Corporation, in collaboration with Professor Arthur C. Ruge of Ruge-DeForest, Inc., consulting engineers of Cambridge, Mass., consultants to Baldwin Locomotive Works, has devised an electronic means of sensitively measuring and recording the torque developed in tapping under any known set of controllable conditions. The equipment used, known as a "torque-meter," is portable, permitting tests to be made under shop, as well as laboratory, conditions. Naturally, this feature provides a means of testing many factors that previously could not be checked.

The torque-meter measures the torque produced as a result of the combined effects of tap design, speed, lubricants, etc., any individual factor being isolated by changing it while the other conditions remain constant. The resulting change in torque measurement accurately indicates the effect of the factor under investigation. These torque tests will materially increase pres-

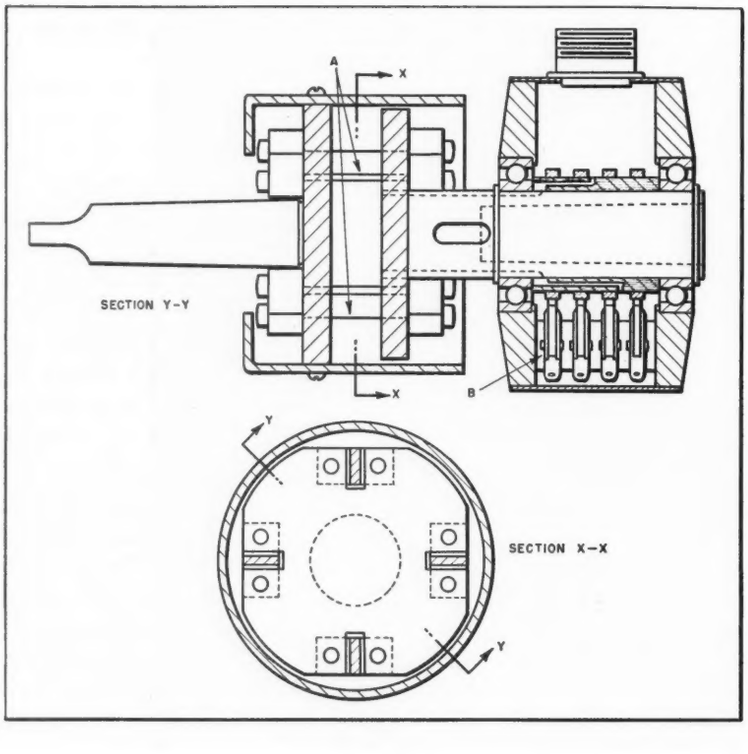


Fig. 1. Cross-sectional diagram of the tapping torque pick-up section of torque-meter. Strain gages, bonded to torque-sensitive axial beams (A), transmit strain to a Wheatstone bridge circuit, which provides an accurate means of measuring the torque

ent knowledge of tap design, and will greatly improve tapping methods. An especially important result of research with the torque-meter will be the specific information made available to industry on the effects of various tapping conditions.

The equipment consists of a taper-shank torque pick-up, a control box, and a Brush oscillograph and amplifier. Fig. 1 illustrates the torque pick-up section, which is assembled in the spindle of a tapping machine by means of its tapered shank.

During a tapping operation, the twisting effort imposed on the tap is imparted to four torque-sensitive axial beams *A*. To each of the beams are bonded special Baldwin SR-4 strain gages, connected to a Wheatstone bridge circuit which measures electrical resistance and whose unbalance becomes a measure of stress change. The torque carried by the beam is transmitted to the strain gages, which consist principally of fine wires that stretch and contract with strains in the surface to which they are bonded. The electrical resistance of these wires varies with elongations or contractions of the gage, thereby disturbing the balance of the bridge circuit, which affords a precise measure of the strain.

A non-rotating brush assembly *B*, supported on the female taper by ball bearings, contacts silver slip-rings on the shaft, providing connections for applying voltage to the bridge and for measuring the unbalance signal, which is exactly proportional to the applied torque. A transformer in the control box supplies voltage to the pick-up bridge and also to a second (internal) bridge, which can be unbalanced to provide zero setting and calibration signals. A range switch selects the whole or precise fractions of the pick-up bridge output to add to the internal bridge output and deliver to the amplifier.

To provide for various tapping conditions, the torque pick-up sections are made to handle three different ranges of torque. One measures torque in increments of 0 to 50, 0 to 100, and 0 to 150 inch-pounds; another pick-up has a range of from 0 to 450 inch-pounds, measuring torque in increments of 0 to 150, 0 to 300, and 0 to 450 inch-pounds; while a third measures torque from 0 to 500, 0 to 1000, and 0 to 1500 inch-pounds.

Variations in torque, as reflected by the am-

plified bridge circuit, are transmitted to a pen motor in the oscillograph. This provides a visual record on a tape similar to the charts illustrated in Fig. 2. The tape is graduated in millimeters, and since the pen has a maximum sweep of 30 millimeters, each graduation has a value determined by the range setting of the torque-meter. For example, with a setting of 100 inch-pounds, each millimeter on the chart has a value of $100 \div 30 = 3.33$ inch-pounds. In chart *A*, it can be seen that the torque developed is equal to $21 \times 3.33 = 69.93$ inch-pounds, maximum.

For ordinary purposes, a plastic scale graduated to convert millimeter readings to inch-pounds is placed on the tape, thus enabling quick reading of test results. For precise records, a direct reading is made with a microscope or magnifying glass, and the reading converted mathematically into inch-pounds of torque.

The data given on chart *A* indicates that a certain size high-speed steel commercial ground gun tap was used to tap a hole 9/16 inch deep with 75 per cent depth of thread in oil-hardening tool steel at a spindle speed of 600 R.P.M. The material being tapped had a Brinell hardness of 200, and a sulphur-base cutting oil was used as a lubricant. Comparing the data given on charts *A* and *B*, it will be seen from chart *B* that using a plug tap in place of a gun tap causes a marked increase in the torque developed. Here, with all other conditions the same, the torque measures 93 inch-pounds, compared to 69.93 inch-pounds of torque developed by the gun tap. These measurements are given as examples, and will, of course, vary with different conditions. They are not to be interpreted as being representative measurements for the taps described.

Fig. 3 illustrates the torque-meter assembly in operation. A floating tap-holder, which insures tap alignment (thereby facilitating the test), can be seen at *A*. An adjustable clutch that prevents overloading of the torque-meter is shown at *B*. The torque pick-up section, including the strain-gage housing, as well as the brush housing and connection to the oscillograph, is indicated at *C*.

To insure a positively true reading, the circuit is calibrated before and after each reading. In this way, if any differences occur in the torque range reading, they are known to be due to variations in the circuit and not in the tapping set-up.

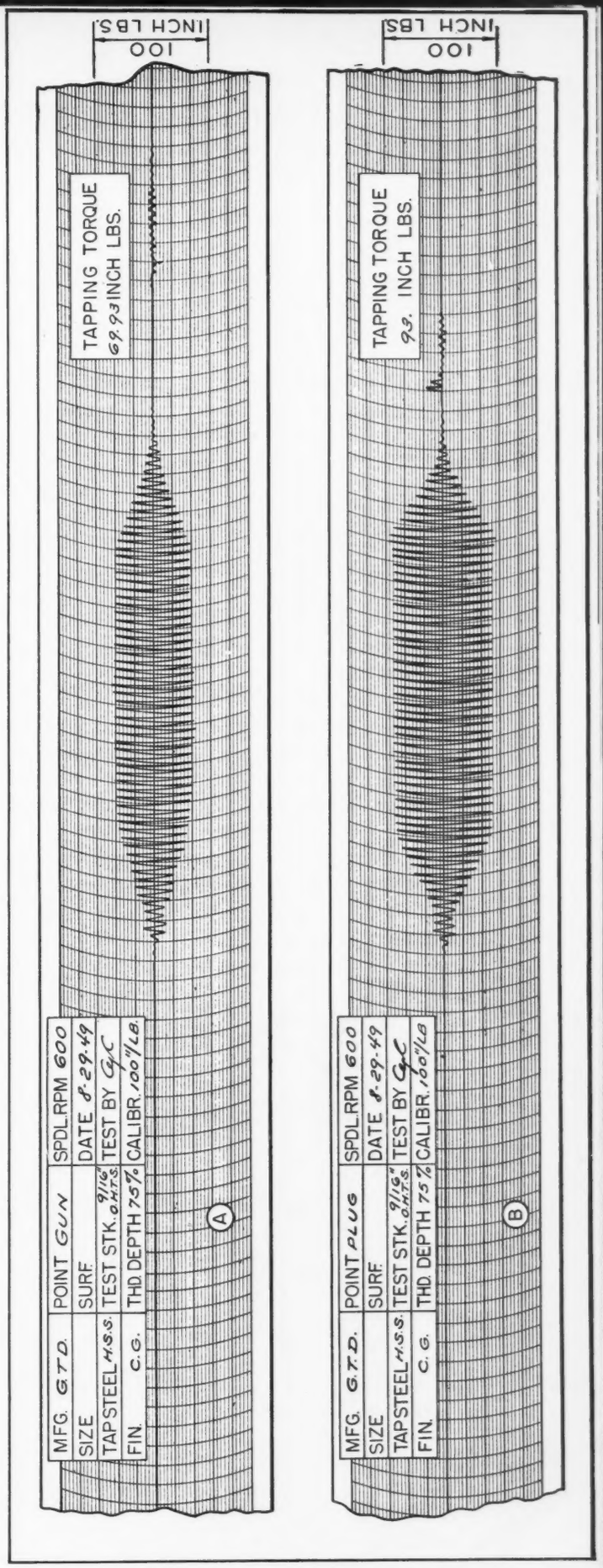


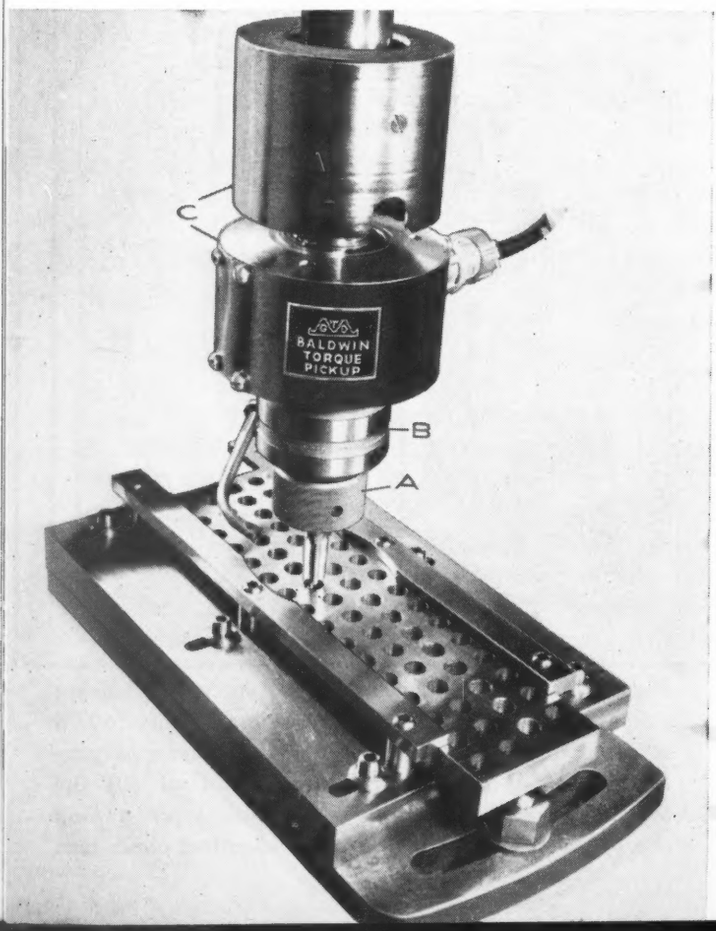
Fig. 2. Sections of an oscillograph tape, showing at (A) permanent record of tapping torque (69.93 inch-pounds) developed by a gun tap under a particular set of tapping conditions, and at (B) the tapping torque record (93 inch-pounds) for a plug tap of the same size tested under identical conditions

The sensitivity of the torque-meter is such that even the torque due to the inertia of spindle reversal is registered in these readings. This may be seen in Fig. 2 by the short oscillations following those indicating the tapping operation.

The accuracy of torque measurements with this equipment is such that errors are no greater than plus or minus 1 per cent. It is interesting to note that when this small degree of error (less than 1 per cent) is found in tests, it is the result of tap design and manufacturing discrepancies rather than other factors.

The original calibration of the torque-meter and all periodic recalibration checks are accomplished through the application of a calibrating device consisting of a precision moment arm and accurate dead-weights for each of the individual torque ranges.

Because these tests are made on a comparative basis, with uniformity of set-up conditions closely controlled, a high degree of accuracy is obtained. One of the most important of these conditions—uniformity of hole size—is established to a fine degree by precision reaming after drilling. Likewise, in all cases of comparative tapping torque measurement, except under special conditions, the thickness of plate governing the length of thread tapped is 1 1/2 times the nominal tap diameter, which conforms to standard practice.



Conventional tapping conditions are employed and rigidly controlled to prevent picking up inaccuracies in the oscillograph. The materials tapped in the tests are those most universally employed in machining operations, including cast iron and free-machining screw stock, as well as tool steels. The latter are often heat-treated to various degrees of hardness in order to decrease the number of tests required in determining tap life. Life tests are accelerated in the ratio of approximately 20 to 1 by the use of tool steel heat-treated to a hardness of 32 Rockwell C.

The following example showing the results obtained by studying an actual production tapping job with a torque-meter will serve to indicate the value of this new method of measuring tapping torque. An automotive brake adjustment nut made of S A E 1035 steel had a blind bottoming hole 1 5/8 inches deep in it. This was to receive a 7/16-20 tap with a full thread depth of 1 1/2 inches to gage. The original design of tap used for this job failed in every case after a maximum number of 50 pieces had been tapped.

Analyzing these taps with the torque-meter showed that a tapping torque of 30 inch-pounds was developed with a full depth of thread 3/8 inch from the bottom of the hole. A rapid increase of torque to a maximum of 450 inch-pounds was developed from that point to the point of reversal at the bottom of the hole.

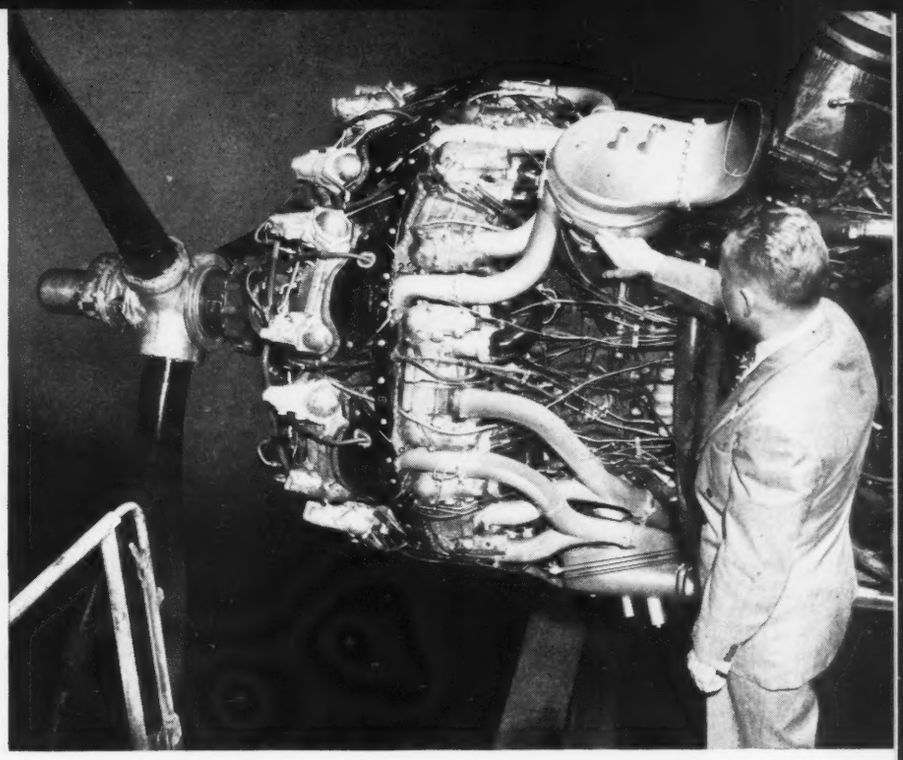
To reduce this increase in torque, the tap design was materially altered. Tests were then made with the new design under the same tapping conditions. Tapping torque remained the same to within 3/8 inch from the bottom of the hole, but the torque increased to only 95 inch-pounds the rest of the way, providing a full thread depth of 1 1/2 inches. This tap produced 4500 holes, and was resharpened at the point to produce 4200 more with complete satisfaction.

From the foregoing, it can be seen that the torque-meter, by permanently recording test results for careful analysis, provides a means of improving tap design and tapping practice.

Fig. 3. Torque-meter assembly in operation. A floating tap-holder for aligning the tap is shown at (A), an adjustable clutch that prevents overloading of the torque-meter at (B), and the torque pick-up section at (C)

Welding in an Aircraft-Engine Plant

By GEORGE H. DeGROAT



Techniques Employed by the Wright Aeronautical Corporation in Fabricating the Velocity Turbines for the "Turbo-Cyclone" Engine

WELDING processes in the aircraft industry are closely controlled to insure the high quality of parts required. At the plant of the Wright Aeronautical Corporation, Wood Ridge, N. J., a materials testing laboratory is maintained, which is used extensively in determining the efficiency of various methods of welding alloy sheet metal and castings. This laboratory is equipped with apparatus for testing welded joints of various parts and of different combinations. These tests guide the development of production welding methods.

The facilities of the laboratory were particularly advantageous in determining welding techniques for fabricating the velocity, or "blow-down," turbines used in the Wright "Turbo-Cyclone" engine. This power plant, shown in the heading illustration, combines an eighteen-cylinder reciprocating engine with three turbines which operate on exhaust gases. The exhaust gases are converted into power, which is geared back directly to the crankshaft, adding 20 per cent to the horsepower developed by the engine for the same fuel consumption.

The main parts of the turbines are made of such high-temperature-resistant materials as Inconel, Inconel X, and Stellite, which are relatively difficult to weld. These materials are chemically and mechanically stable at the elevated temperatures which the turbines must withstand in operation, and have excellent resistance to oxidizing, reducing, and other high-temperature corrosive atmospheres.

The dimensions of the welded parts of the turbine housing are held to plus or minus 0.030 inch by means of the extensive use of jigs and fixtures. Inasmuch as a large part of the turbine is made of relatively thin sheet metal, well designed jigs are highly important. Thin sheets tend to become greatly distorted under welding heat, and there is need for a means of controlling warpage by absorbing or equalizing the effects of heat. Welding heat sets up stresses in the metal, complicating welding procedures and necessitating especially good techniques and subsequent stress relieving of each weldment.

An important part of the turbine housing is the nozzle-box section, which consists principally of a cast nozzle and blades and Inconel sheet-metal inlet ducts. The jig used in aligning these components of the nozzle box accurately clamps them in the correct position relative to each other for butt-welding. After a guard ring has been tack-welded to the center, the Heliarc inert-gas shielded-arc welding method is used for joining the assembly. Straight-polarity, 90-ampere direct current is used with a welding speed of 2 to 3 inches per minute.

Fig. 1. Joining cast Stellite blades to an Inconel-X forging by metal-arc welding, to form the velocity turbine rotor wheel

Inconel, stainless steel, aluminum, and Stellite are readily joined by inert-gas shielded-arc welding, which is the method chiefly used for joining sheet-metal turbine parts of 0.018 to 0.125 inch thickness. Argon is generally used as the gas shield to prevent oxidation of the molten metal and the electrode, not only because it produces a cleaner weld, but also because the arc voltage for a given current is lower with argon than it is with helium. The heat transmitted to the work, therefore, is low, minimizing the danger of burning thin sheets.

Helium, however, is employed as a shield in applications where deep penetrations are required. One of the principal advantages of this method of welding lies in the fact that flux is not required, inasmuch as the argon or helium shield protects the weld from oxidation. This eliminates corrosion resulting from flux entrapments, as well as extensive cleaning after the welding operation.

In Fig. 1, cast Stellite blades and Inconel-X forgings are being joined to form the turbo rotor. Here the metal-arc welding process is used with Inconel 132 coated rods. Before welding, the cast blades are X-rayed in the materials laboratory to check for soundness, and they are also weighed, so that they can be assembled in the rotor wheel progressively to achieve as nearly perfect balance as possible. For example, every fourth blade assembled must be identical in weight, which is also true of every second blade and every third blade, etc.

The blades are precision-cast, so that their contours, including the leading and trailing edges, do not require machining. Their bases are ground before welding to fit precisely together in the wheel. After being welded to the wheel, the assembled blades are ground at the outer periphery and the two side faces of the bases are ground to finished size.

Using the aligning fixture shown in Fig. 1, the blades are fitted tightly into the rotor wheel, maintaining the outside diameter of the assembly. The inside diameter of the wheel is ground to suit the hub diameter, after which a relatively deep weld groove is ground into one side of both the hub and the blade sections. The hub is aligned with the wheel bore by means of fixtures, and three weld passes are made to join these members. After each pass, an air hammer, having a round-nosed impact tool, is used to relieve the stresses in the weldment by peening. Besides relieving welding stresses, the peening operation aids in maintaining diametral dimensions. The same procedure is followed on the opposite side to complete the welding of the hub to the wheel.

To produce the required strength and high

Fig. 2. Cross-section of weld shown being made in Fig. 1, at the junction of the turbine blade and hub

joint efficiency between the wheel and the blades, eighteen continuous weld passes are made on each side of the wheel, with a peening operation after each one. Two operators weld alternately, picking up the arc in the molten pool and thus eliminating the interruptions caused by electrode replacements. The resulting welded structure may be seen in Fig. 2 which shows a cross-section through a blade and the hub.

In order to keep the blades straight in the wheel, the welding is done first on one side and then on the other, balancing the distribution of stresses throughout the wheel. Reverse-polarity 90-ampere direct current is used, with an average welding speed of 3.75 inches per minute. A tensile strength of 81,000 pounds per square inch at operating temperature is obtained in the Stellite blade at the weld by this procedure.

To eliminate craters at the end of a weld, an attachment is used with the metal-arc welder, which gradually reduces the current density. In operation, the arc fades out gradually until the arc current is so low that it can no longer deposit metal. Tapering off the current in this

Fig. 3. Rotor wheel set up for X-ray examination under a 250,000-volt machine, which determines degree of weld penetration, soundness, and uniformity of weld structure

Fig. 4. Fluorescent penetrant inspection equipment is used to detect cracks in weldments of velocity turbine housings

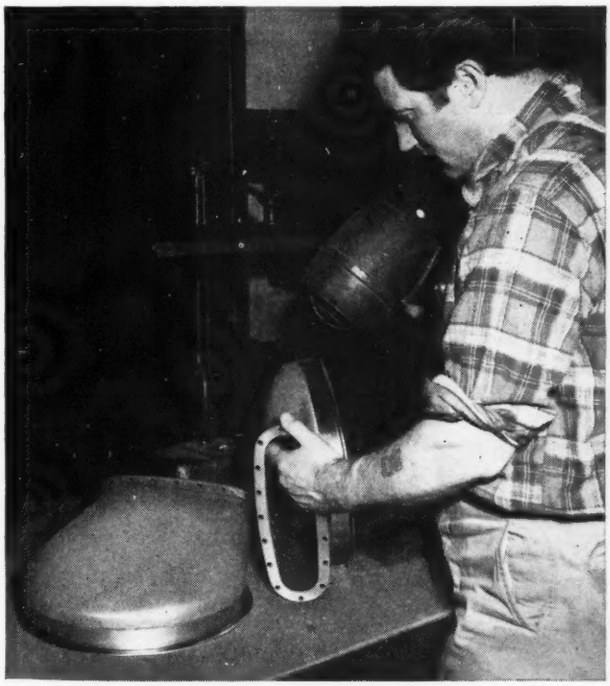


Fig. 5. A turbo-supercharger inducer-impeller is inspected under "black light" for possible forging defects

Fig. 6. A metal-arc welder, an automatic arc-welding head, and a motor-driven positioner used in combination permit submerged-melt, Heliarc, and metal-arc welding to be accomplished in the laboratory, in order to determine the best welding technique for various combinations of materials and different parts

way, instead of changing it abruptly, results in a weld that is free from porosity and smooth in contour. The arc control station used for this purpose consists primarily of a resistance connected in series with the welding leads and controlled by a foot-operated switch.

All welded joints are thoroughly inspected by various methods. For example, the rotor wheel is radiographically inspected by a 250,000-volt X-ray machine, Fig. 3, to determine degree of penetration, soundness, and uniformity of weld structure. This part is also examined visually around the entire welded circumference for surface cracks, under-cuts, and general appearance. An etching solution is employed to obtain a clear definition of the weld structure.

In general, the inspection method used depends largely upon the design of the part, the type of weld, and the thickness of the material. Crater cracks and hot short cracks in non-magnetic materials are detected by means of fluorescent penetration inspection. Turbine housings and a turbo-supercharger inducer-impeller are shown being inspected by this method in Figs. 4 and 5, respectively. Preparatory to inspection, the parts are soaked in a fluorescent penetrant oil for several hours, after which the excess oil is washed off with a water spray. The work is next dipped into a tank containing a finely divided powder suspension developer, and then exposed to a hot-air drying system. Any cracks that may be present in the weldments are then clearly visible under "black light" because the oil, which penetrates the cracks, is drawn up to the surface by the capillary action of the powder.

Throughout all welding operations on the velocity turbines, especial care is taken to insure extremely high joint efficiencies on parts that are heavily stressed in operation. Before using a particular welding method in production, it is thoroughly tested in the materials laboratory, as previously mentioned. Equipment for developing welding techniques may be seen in Fig. 6. A motor-driven work-positioner and a 300-ampere, direct-current, portable arc-welder are used in conjunction with a thyratron-controlled automatic arc-welding head for continuous welding with both alternating and direct current. Arc length, electrode feeding speed, traverse motor speed, etc., can be adjusted at the operator's station. Submerged melt, metal-arc, and Heliarc welding methods can be accomplished with this equipment to determine the most effective means of joining various materials and parts.

What the Taft-Hartley Act Has Cost Labor

ALTHOUGH leaders of labor unions and important personages in the Administration in Washington have been vociferous about the so-called inequalities in the Taft-Hartley Act ever since its enactment, most of the criticisms have been made in terms so general that the impartial observer has experienced considerable difficulty in determining just what is unfair about this legislation.

Perhaps this is a clue: A recent issue of "The Machinist," published by the International Association of Machinists, carries a glaring headline — "Taft Act Cost Us $90,000,000." The article goes on to point out that, whereas I.A.M. members, in 1948, had won wage increases totaling $168,000,000, in 1949, they had achieved wage increases amounting to only $78,500,000. The Taft-Hartley Act is held responsible for the difference.

No mention is made of the fact that, because wages for machinists had on January 1, 1949, attained new heights, a more or less stabilized condition had been reached and the general public was looking for lower product costs. Neither is any mention made of the attainment during 1949 by I.A.M. members of improvements in working conditions, such as health and welfare programs, group insurance, longer vacations, paid holidays, higher second-shift differentials, sick leave, improved classifications, and other fringe benefits. Only one member out of every four failed to get an increase in wages during 1949.

Is it to be assumed from this article in an outstanding labor union paper that labor unions gripe about the Taft-Hartley Act mainly because it prevents them from pyramiding their wages, year after year, despite changes in economic conditions? If this is true, the Act should be considered a boon by the general public because it tends to hold down living costs. We doubt, however, whether the article was intended to reach the eyes of the general public.

The Taft-Hartley Act has, of course, become a political football. Republican leaders in Congress, and foremost of all, Senator Taft, have offered to eliminate any inequities, but the Administration and union leaders have insisted on its complete repeal. President Truman, in his recent State of the Union address, again asked Congress to do so but, it is believed, with tongue in cheek. The Act should be enforced right now to get the coal miners back to work on the basis of a five-day week. But that would prevent the use of the Taft-Hartley Act as a rallying cry for votes in the fall elections.

Charles O. Herb

EDITOR

Franklin D. Jones Retires from MACHINERY'S Staff

FRANKLIN D. JONES, after forty-two years of service on the editorial staff of MACHINERY, retired on January 1. During this period of service, Mr. Jones contributed immeasurably to the upbuilding of MACHINERY'S prestige, both through the medium of his articles in the magazine and the numerous technical books he wrote.

Mr. Jones started with MACHINERY in 1907 in the capacity of associate editor, after having spent ten years on machine construction and design in five different branches of the machine-building industry. From 1907 to 1912, Mr. Jones wrote many articles dealing with machine shop practice and machine design. In 1912, he became head of the book department, and since that time, his work has pertained chiefly to the writing, compiling, and editing of technical books.

In any reference to his books, MACHINERY'S HANDBOOK should come first. As most readers know, the editorial team of Erik Oberg and Franklin D. Jones produced the HANDBOOK, in so far as the selection, classification, and general preparation of the material are concerned. The same editorial team, in 1917, compiled and edited "MACHINERY'S Encyclopedia," a work consisting of seven large volumes.

Since the publication in 1914 of the first edition of MACHINERY'S HANDBOOK, the editorship of this world-famous volume has been entirely under the direction of Mr. Jones. The original edition, which contained 1400 pages, has been constantly revised and greatly enlarged during the last twenty-five years. There have been twenty-eight important revisions, seventeen of which have occurred in the last ten years. The objective in back of each revision has been to make MACHINERY'S HANDBOOK increasingly valuable to its vast number of users. The information compiled in this "Bible of the mechanical industries," as the HANDBOOK is so often called, was not, of course, originated by its editors, but by numerous engineers and other technicians whose composite experiences and experiments extending over many years are represented by the data found throughout the 1911 pages of the fourteenth edition of the HANDBOOK.

Mr. Jones, as editor, has had to select from the great mass of available material the particular information which he had reason to believe would prove the most useful to the largest number of HANDBOOK users and then present this material as tersely and clearly as possible. The magnitude of Mr. Jones' achievement on this one job alone is obvious. The tremendous sale of over 860,000 copies of the HANDBOOK indicates that his editing job has met with the approval of a very large and discriminating group of men in the engineering field the world over.

In addition to the editorial work on MACHINERY'S HANDBOOK, Franklin D. Jones has been the author, co-author, and editor of a con-

siderable number of books dealing chiefly with the general subjects of machine building and machine design. These works include "Machine Shop Training Course" (two volumes), "Gear Design Simplified," "Engineering Encyclopedia" (two volumes), "Ingenious Mechanisms for Designers and Inventors" (two volumes), "Die Design and Diemaking Practice," "Jig and Fixture Design," "Mechanical Drawing," and a number of other treatises which are not included in this list because they are out of print.

Mr. Jones will now be able to devote time to the widespread interests which he has cultivated. He will probably spend many days in the pursuit of his favorite sport, golf (he shoots in the 70's), and in painting landscapes, an art in which he excels. MACHINERY wishes him many years of happiness in his well earned leisure.

At a testimonial dinner tendered Mr. Jones on January 12 by his intimate business associates, he was presented with a silver tray and a scroll expressing the esteem of his co-workers and their appreciation of his achievements.

Holbrook L. Horton has been appointed head of the book department. Mr. Horton is a graduate of Worcester Polytechnic Institute, with thirteen years' experience in the electrical and manufacturing industries, during which time he was manager of the statistical department of the National Electrical Manufacturers Association. He has been on MACHINERY'S editorial staff ten years, and for the last seven years has been assistant to Mr. Jones in editing MACHINERY'S HANDBOOK and other engineering volumes. He is the author of "Mathematics at Work." Mr. Horton has been active in the affairs of the American Society of Tool Engineers, and has served as chairman of the Greater New York Chapter. He is the representative of the A.S.T.E. on the Technical Societies Council of New York.

New Britain Brings Industry and Schools Together

A PLAN for bringing the teachers in the public schools into closer touch with the industries of the city, in order to show them what industry makes and how it makes it and to dramatize how the products of industry contribute to the well being and comfort of men and women in every walk of life, has been inaugurated by the manufacturers of New Britain, Conn.

The entire teaching force of the public schools is invited on a day set aside for the purpose to visit the principal companies in the city so as to obtain a thorough insight into the general workings of an industrial plant. The teachers are divided into groups, each group visiting one particular plant, where the products of that organization are exhibited and a tour arranged through the plant to show the methods of manufacture. Lunch is served to the visiting teachers and brief talks are made, bringing out various facts seldom brought to the attention of those whose responsibility it is to impart information to the coming generation of citizens.

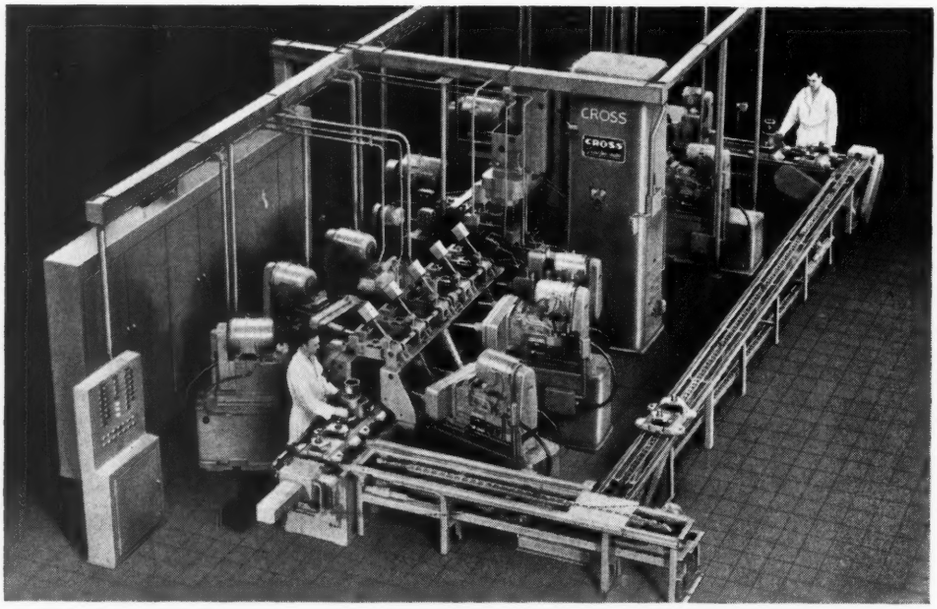
For example, in the talks that were arranged in connection with the plant visits inaugurated last fall were the answers to questions like this: "What happens to the money brought into New Britain from the sale of products made by its nine largest manufacturers?" It was explained in detail how much the sales of these nine manufacturers amounted to in a year and how this money was spent for raw materials, supplies, fuel, and taxes to the city, state, and federal governments. The cost of selling and advertising was recorded in detail, and the amount that went into pay envelopes of shop and office workers and the salaries of the management was given. Then followed information on how much was paid out in dividends to the stockholders. Finally, it was shown how much was put back into the enterprise in the form of new machinery and equipment.

Many of the teachers had no idea, for example, that of what remained after raw materials, taxes, and selling costs had been met, 83.73 per cent went into the pay envelopes of the shop and office workers, while only 1.72 per cent went into salaries to executives of the management, and 5.55 per cent was paid in dividends to the stockholders. Nine per cent was used to buy new machinery and equipment. A history of the plants and their gradual development was covered in a booklet entitled "New Britain—An Industrial City," a copy of which was handed to each teacher.

The nine New Britain companies that cooperate in this work are: American Hardware Corporation, the Fafnir Bearing Co., Landers, Frary & Clark, New Britain Machine Co., North & Judd Mfg. Co., the Skinner Chuck Co., the Stanley Works, Tuttle & Bailey, Inc., and Union Mfg. Co.

The methods that have been so successfully inaugurated and applied in New Britain could well be used in many other industrial cities.

Machining Automotive Transmission



Cases for a New Automatic Transmission are Drilled, Reamed, Bored, and Tapped at the Rate of Sixty-Seven per Hour on Fully Automatic Machine Tools

CAST-IRON cases for a new automatic transmission are being drilled, reamed, bored, and tapped on completely automatic machine tools developed by The Cross Company, Detroit, Mich. On the largest machine—a transfer type of machine known as a "Transfermatic"—forty-eight different holes are cut by eighty-four tools. A production of sixty-seven transmission cases per hour is obtained on this machine with only two operators, working at 80 per cent efficiency.

When the cast-iron transmission cases are received at the five-station indexing machine, Fig. 1, they have been bored, faced, and milled, and two locating holes have been drilled and reamed in the front face. The part is placed on two loading rails, with the rear face down, at the first station of this drilling and reaming machine. After sliding the part into the fixture, a hand-lever is depressed to actuate a cam-controlled lifter plate. This plate raises the casting so that two pins enter holes in its top face, thus accurately locating and securely clamping the part for the machining operations. As soon as the operator has unloaded and reloaded, he pushes a button to start the cycle again. No time is lost during loading, since the machine is in continuous operation.

Automatic indexing of the five-station table is accomplished by means of a fluid motor drive mechanism instead of the conventional Geneva wheel. The fluid motor drives a worm and worm-wheel directly connected to a pinion which rotates a large-diameter ring gear. The table gradually decelerates as it comes to each station, and is accurately stopped by means of a cam-operated limit switch. Final location is effected by a shot-pin, working in sequence with the rotating mechanism.

The machine has one twenty-three-spindle vertical head, which operates simultaneously at all four cutting stations; two single-spindle, angularly-mounted heads, both of which operate at the second station; and one four-spindle horizontal head that operates at the fifth station. Drills and reamers employed on the machine range from 5/16 to 5/8 inch in diameter. The drills are rotated at a surface speed of 80 feet per minute, and the reamers at 55 feet per minute. The twenty-three tools on the vertical head are fed downward at the rate of 5.87 inches per minute; the 3/8-inch diameter drills on both angular heads are fed at 4.89 inches per minute; and the four drills on the horizontal head are fed at the rate of 5.1 inches per minute.

One 3/8-inch diameter hole and one 9/16-inch diameter hole are progressively drilled to the required depth of 6 3/4 inches at Stations 2, 4,

and 5. The total cycle time is forty-two seconds, giving a production of eighty-five pieces per hour at 100 per cent efficiency, or sixty-eight pieces per hour at 80 per cent efficiency.

The partially machined transmission cases are then conveyed to the fifteen-station Transfermatic seen in the heading illustration which machines forty-eight different holes in the casting with eighty-four tools, as previously mentioned. The cycle time for the longest operation is thirty-four seconds; two seconds are required for clamping and two for unclamping; and five seconds for transferring from station to station, resulting in a total machine cycle time of forty-three seconds. This gives a production of eighty-four pieces per hour at 100 per cent efficiency, or sixty-seven pieces at 80 per cent. One of the two operators loads the machine, while the other unloads and also runs the tapping machine.

The part is loaded on a pallet type fixture at the front of the machine, seen in the left foreground, and two clamps on the pallet are tightened by the operator. Transfer of the pallets from station to station is accomplished by means of a hydraulically actuated transfer bar extending the length of the machine beneath the pallets, which has fingers projecting upward between the pallets. When the work has been transferred to successive stations, a rack and pinion arrangement actuated by another hydraulic cylinder rotates the bar one-quarter of a revolution. The transfer fingers are then clear of the pallets and the bar is returned to its starting position.

Accurate location of the work-holding pallets at each station is insured by hydraulically actuated shot-pins that enter holes in diagonally opposite corners of the pallet. Simultaneously, cam-actuated clamps contact the top of each work-piece, thus providing additional means of securing the part to the pallet and clamping the pallet to the ways of the machine. Both locating and clamping are accomplished through the action of one hydraulic cylinder.

Twenty work-holding pallets, which are made from hardened and ground alloy steel castings, are provided. Seventeen of the pallets are located in the machine proper, while three are on the rapid-return conveyor seen along the right-hand side of the machine. The chain conveyor is automatically operated when the transfer bar is in its forward position. Dogs on the chain contact the loaded pallet in the last station of the machine, Fig. 2, conveying it to the unloading operator seen at the rear of the machine in the background of the heading illustration. When this operator has unclamped the transmission case and placed it on the tapping machine, he presses a "cycle release" button, which permits the operator at the front of the machine to start another cycle. The next loaded pallet coming out of the machine pushes the empty pallet onto the chain conveyor running alongside the machine, which carries it back to the loading operator while the machine is in operation.

Thirteen standard machining heads, lettered *A* to *M*, inclusive, are employed on the fifteen-station machine. The operations performed at different stations by the various heads and the feeds and speeds of the cutting tools are given in the accompanying table. A close-up view of the tooling mounted on vertical head *I* at Stations 7, 8, and 9 is shown in Fig. 3. Screw type chip conveyors transport chips from both halves of the machine toward Stations 10 and 11, which

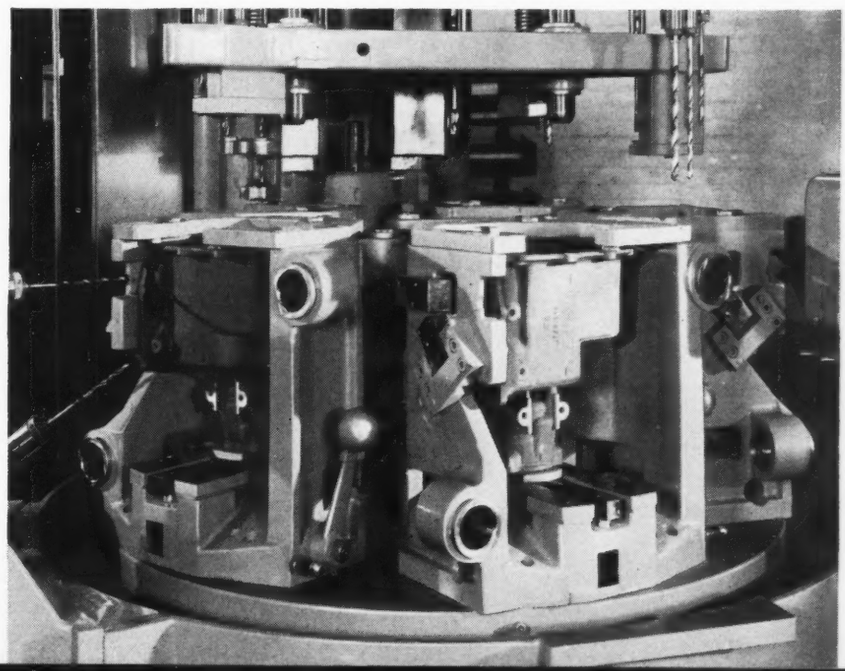


Fig. 1. Close-up view of the fixtures employed on a five-station, rotary indexing machine for drilling and reaming automatic transmission cases

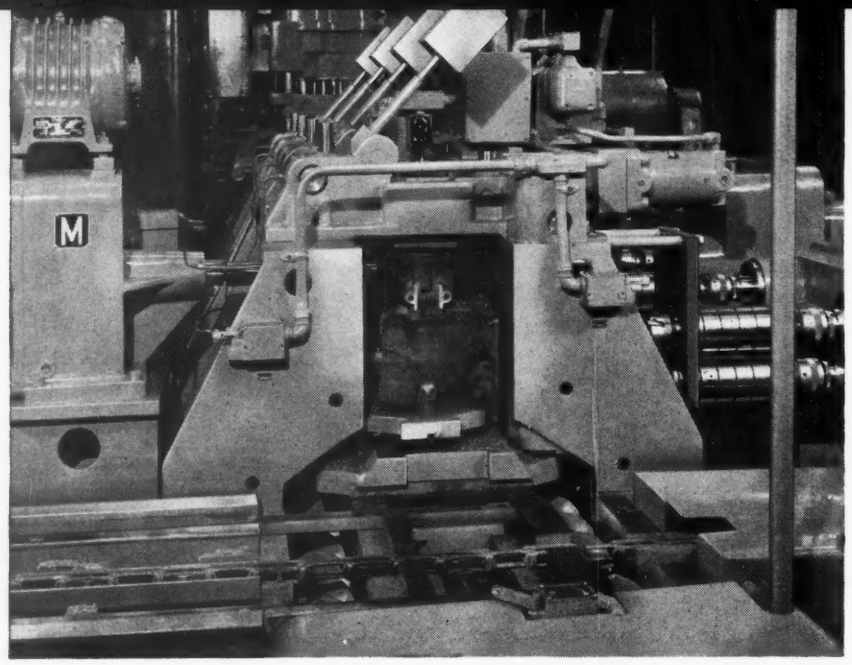


Fig. 2. Exit end of transfer machine seen in heading illustration. Dogs on the chain seen in the foreground convey the loaded pallet to the unloading station

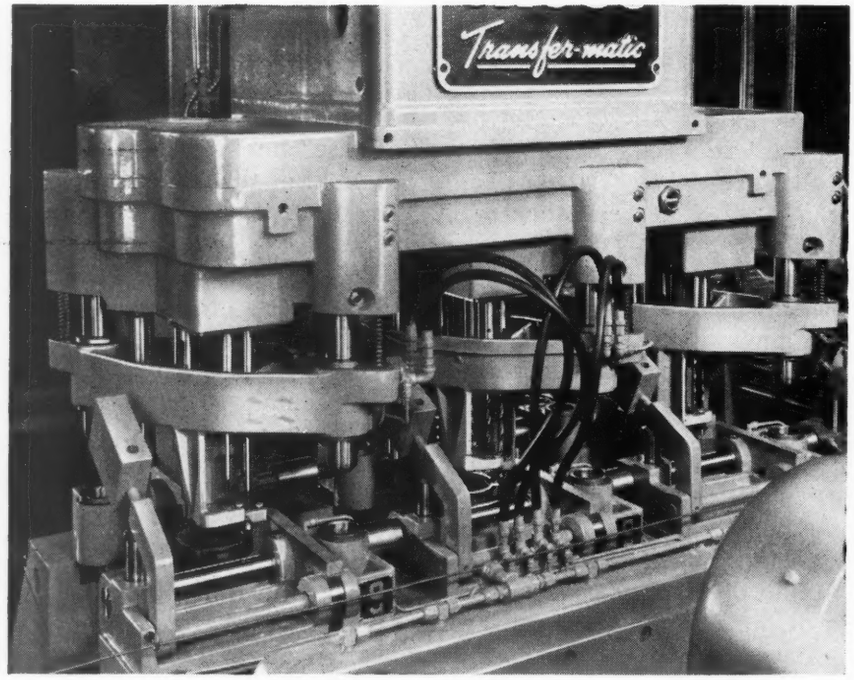


Fig. 3. Close-up view of the tooling mounted on a vertical head at Stations 7, 8, and 9 of the transfer machine. Operations performed at these stations are listed in the accompanying table

Fig. 4. A tool rack holding two sets of tools and a complete set of tool-setting gages eliminates the machine "down time" usually required for setting and adjusting the tools while they are in the machine

are both idle. A conveyor is provided below the floor level at this location to carry the chips away from the machine.

For drilling deep holes, where progressive operations are required to bring the hole to the desired depth, a feeler type depth gage is provided which enters the hole and automatically retracts the head if a previous operation is incomplete or if a broken drill or other obstruction should be in the hole. In such cases, a limit switch is tripped, automatically stopping the machine. Signal lights on the master control station identify the station where the trouble has occurred. Recycling is prevented until the defect has been corrected.

A very smooth surface finish is required on the 3 1/4-inch diameter holes for the Servo mechanism that are rough-, semi-finish-, and finish-bored at Stations 13, 14, and 15. Special four-bladed, tungsten-carbide tipped cutters are employed for these operations. High-speed steel reamers are mounted in the center of the finish-boring tools to ream holes 5/8 inch in diameter at the same time that the Servo holes are bored. Tapping of the speedometer drive hole at Station 15 is the only one in which a cutting fluid is employed. Here a mist of oil, carried in a stream of compressed air, is blown on the tap after each operation.

A unique, time-saving tooling feature on this and other machines in the production line is the provision of a complete set of tool-setting gages and a special tool rack, Fig. 4. The gages permit setting and checking of all tools before they are placed in the machine. Two complete sets of tools can be pre-set and placed in their proper position in the tool rack.

Each section of the rack is identified by a color indicating whether the tool is to be used on the right-hand or left-hand side of the machine or on the vertical head. Identification tags are also provided on the rack, directly below the opening for the tool, which give the letter of the head and the number of the station that the tool is to be used in and the hole in the transmission case that the tool machines. Where the tool is an assembly of adapters, nuts, etc., the tool and part numbers of the sub-assemblies are also listed on the tag.

Since it is not necessary to set or adjust tools while they are in the machine, "down time" for this operation is eliminated and the operating efficiency of the machine is increased. In addition, less time is required to change tools, since they are pre-set. The tool rack also makes possible a fast visual check of the number of sharp-

Operations Performed in Machining Transmission Cases on a Fifteen-Station Transfer-matic

Station	Head	Holes		Operation	Feed Stroke, Inches	Feed Rate, Inches Per Min.	Machining Time, Sec.
		Number	Size				
1	A, H	2	7/16	Drill	1 9/16	3.75	26
2	A, H	2	1 3/16	Counterbore	1 9/16	3.75	26
2	B	2	1/4	Drill	2 3/8	5.48	26
2	B	1	35/64	Drill	2 3/8	5.48	26
3	B	1	1/4	Drill	2 3/8	5.48	26
3	B	1	3/8	Drill	2 3/8	5.48	26
3	B	1	9/16	Drill	2 3/8	5.48	26
3	K	1	45/64	Drill	1 1/4	6.24	12
4	C	1	5/16	Drill	2 1/2	6.60	23
4	K	1	3/4	Drill	1 1/4	6.24	12
5	C	1	3/8	Drill	2 1/2	6.60	23
5	C	1	9/16	Drill	2 1/2	6.60	23
5	L	1	1 3/8	Counterbore	1 1/2	3.20	29
6	E	1	9/16	Ream	1 1/2	8	12
7	I	1	1/4	Drill	1 7/8	4.5	26
7	I	3	5/16	Drill	1 7/8	4.5	26
7	I	1	21/64	Drill	1 7/8	4.5	26
7	I	1	3/8	Drill	1 7/8	4.5	26
7	I	1	9/16	Drill	1 7/8	4.5	26
8	D, I	17	17/64	Drill	1 9/16	5.5	17.2
8	I	2	21/64	Drill	1 7/8	4.5	26
8	D	1	3/8	Drill	1 9/16	5.5	17.2
8	I	1	1 1/4	Spot-Face	1 7/8	4.5	26
9	D	1	17/64	Drill	1 9/16	5.5	17.2
9	I	3	5/16	Drill	1 7/8	4.5	26
9	I	1	11/32	Drill	1 7/8	4.5	26
9	D, I	4	3/8	Drill	1 7/8	4.5	26
9	D	2	37/64	Drill	1 9/16	5.5	17.2
9	I	1	29/32	Counterbore	1 7/8	4.5	26
12	J	1	5/16	Drill	1 1/4	3.1	26
12	F	14	3/8	Countersink	1 11/32	3.2	26
12	F	2	5/8	Ream	1 11/32	3.2	26
13	J	1	7/8	Spot-Face	1 1/4	3.1	26
13	F	1	25/32	Drill	1 11/32	3.2	26
13	F	2	3 3/16	Bore	1 11/32	3.2	26
14	G	1		Recess	1 1/4	2.88	26
14	G	2	3 1/4	Bore	1 1/4	2.88	26
15	M	1	13/16	Tap	2.35	....	30
15	G	2	3 1/4	Bore	1 1/4	2.88	26

Heads *A* to *G*, inclusive, are mounted on the left-hand side of the machine; head *I* is vertical; and heads *H*, *J*, *K*, *L*, and *M* are mounted on the right-hand side of the machine.

Cutting speeds, in surface feet per minute, are: Taps, 40; reamers, 75; drills, 80; counterbores, 150; and boring tools (roughing), 200 and (finishing), 300.

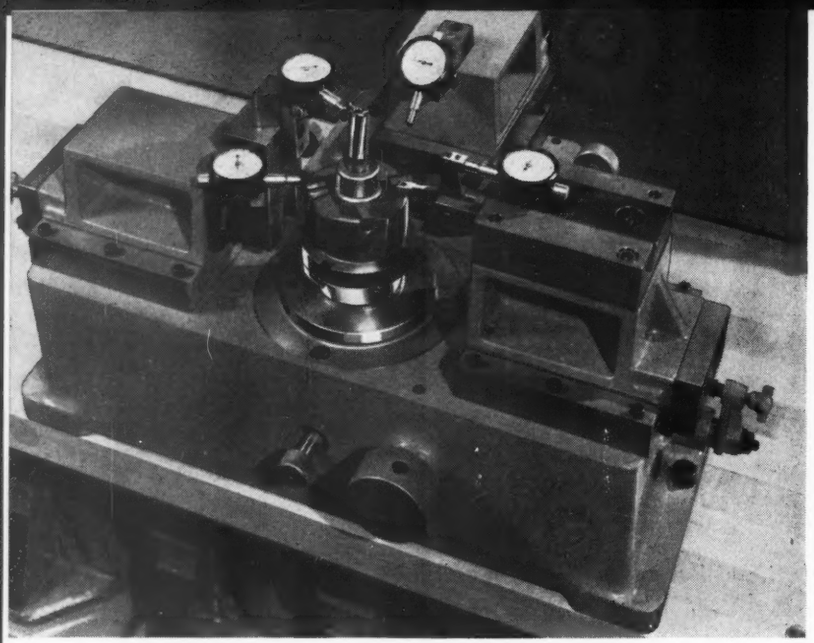
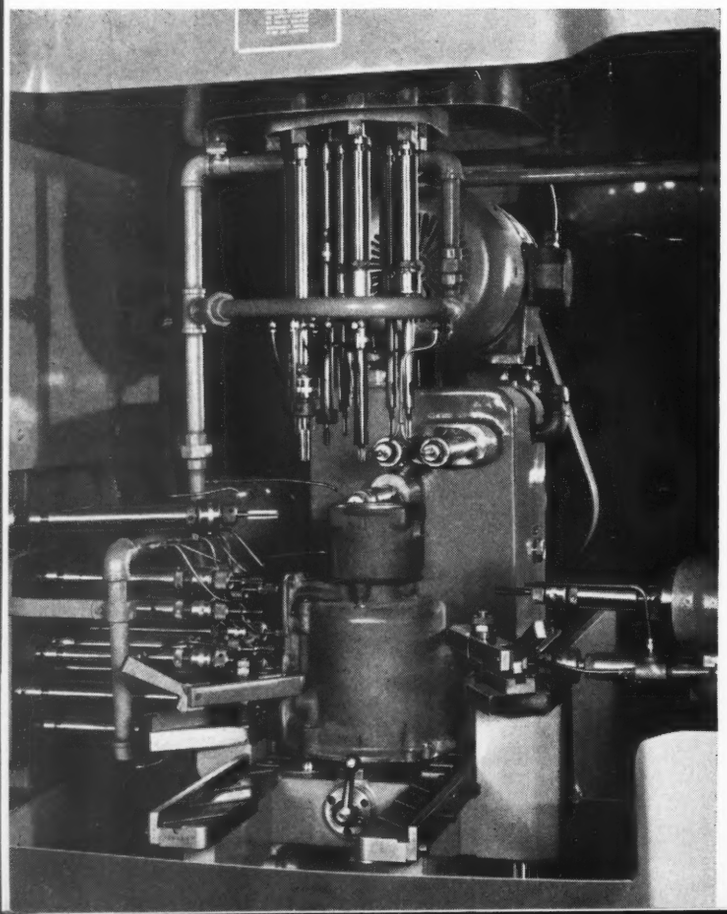


Fig. 5. Precision gage that is equipped with dial indicators for inspecting the carbide-bladed tools used for boring Servo holes in the automatic transmission cases

ened tools on hand, ready for use, thus minimizing the possibility of losing production time waiting for tools to be sharpened.

A hardened and ground steel tool-setting fixture is provided on the working bench surface of the tool rack. Gage-rods, such as the one seen in the center of the illustration, are used for setting the lengths of drills and reamers where the depth of hole is not too critical. Such rods are kept in holes in the face of the tool rack, adjacent to the tools with which they are used.

On counterboring tools, spot-facers, or other tools used for machining holes to close-tolerance depths, a stand comprising a flush-pin gage (seen at the right) is used for setting. Fifteen of these gages, for different depths, are stored under the bench. The carbide-bladed tools for boring the Servo holes are inspected for run-out and size on a dial indicator gage, Fig. 5, using a master similar in outline to the tool.



Twenty-nine holes are tapped in the automatic transmission case in one operation on the machine seen in Fig. 6. This four-way tapping machine is provided with one left- and one right-hand head, a head at the rear of the machine, a vertical head, and two angularly mounted heads. Each tapping spindle is equipped with an individual lead-screw feed. All spindles have a safety feature that prevents damage in case a tap should come in contact with an obstruction, such as an undrilled hole or a broken tool.

The part to be tapped is placed on guide rails at the front of the machine, slid manually into place in the fixture, and locked by means of hand clamps. After the taps mounted in the left- and right-hand heads have completed their threading operations, the fixture is automatically elevated by means of an air cylinder to the second tapping position. Taps in the top and rear heads, as well as in both angular heads, then come into operation, after which the fixture is automatically lowered for unloading and reloading.

The four-station index machine shown in Fig. 7 is employed to drill three angular holes and tap six flange holes in each automatic transmission case. The total cycle time for this operation is sixty-one seconds, and since two parts are loaded at a time, a production of ninety-four cases per hour is obtained with 80 per cent efficiency. Automatic indexing of the table is accomplished by means of a fluid motor drive mech-

Fig. 6. Four-way machine for tapping twenty-nine holes in an automatic transmission case in one operation. The fixture is automatically elevated to the second tapping position after the taps mounted in the left- and right-hand heads have been withdrawn

Fig. 7. Four-station index machine which drills six angular holes and taps twelve holes in two parts every sixty-one seconds. A dual feed rate is employed for most economical drilling of the angular holes

anism, similar to the one employed on the five-station machine previously described.

The drills are rotated at 80 surface feet per minute, while the taps operate at 40 feet per minute. A dual feed rate is provided for economical drilling of the angular holes. An initial slow feed of 0.002 inch per revolution is used until the drills have produced full-diameter holes in the angular faces of the transmission case, at which time the feed is increased to 0.004 inch per revolution. When the full-diameter holes are started, the tungsten-carbide drill bushings are automatically withdrawn from the faces of the work by means of rollers acting on cam surfaces. This allows free flow of chips from the holes. Individual lead-screw tapping spindles are mounted on the vertical head at the fourth station of the machine.

Limit switches used on all of these machines have Plexiglas covers that permit visual inspection of the functioning of the switch. All hydraulic valves and panels are manifold mounted.

* * *

Mercury-Turbine Electric Power Generating Unit

What is believed to be this country's only industrial installation of a mercury-turbine electric power generating unit is now supplying power and heat to the Transformer and Allied Product Divisions plant of the General Electric Co. in Pittsfield, Mass. This unit, of 7500 kilowatts capacity, has been added to an existing steam station. Included in the system are a mercury boiler, mercury-turbine generator, and two condenser boilers. Pulverized coal is burned in the boiler to vaporize the mercury, which is then passed through the mercury turbine. The latter, in turn, runs electric generators. After the mercury vapor has passed through the turbine, it goes into the condenser boiler, where enough heat is given off to turn water into high-pressure steam.

Turbo-Prop Aircraft Engine of 5500 Horsepower

The T40 turbo-prop aircraft engine, recently exhibited to the public for the first time by the Allison Division of the General Motors Corporation, delivers more than 2 H.P. for each pound of engine weight, including extension shafts and the reduction gear. The importance of this fact will be apparent when it is remembered that the best piston type engines used during World War II delivered only about 1 H.P. per pound of weight.

The new engine is rated at 5500 H.P. It is of a completely new design, consisting of two axial-flow gas-turbine power sections, both of which drive extension shafts to a common reduction gear, which, in turn, drives contra-rotating propellers. The power sections are connected so that they form a single unit, but each power section can be operated independently. This feature permits an aircraft to take off at full power with both sections operating. Then, to obtain maximum fuel economy in flight, one power section may be shut off and the other operated at its most efficient point.

* * *

How to Set Up an Industrial Eye-Safety Program

A booklet containing suggestions on how to establish a program of eye safety through the use of safety goggles has been published by the American Optical Co., Southbridge, Mass. The booklet gives information on how to obtain the necessary professional services to implement an eye safety program and step-by-step instructions on the use of a new Safety Rx Order Book supplied by the company. The data presented is based largely on existing practices in some of the country's largest industrial plants. Copies of the booklet are available upon request to the company at the address given above.

Rapid Milling of Cam Paths in Gun-Bolt Sleeves

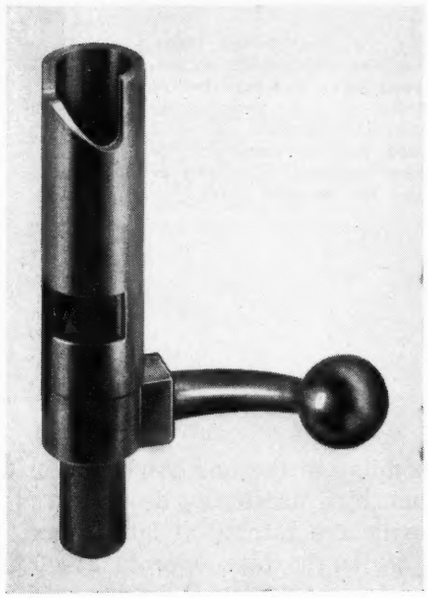


Fig. 1. Gun-bolt sleeve in which a V-shaped cam path is milled on the machine shown in Figs. 2 and 3

THE V-shaped cam path seen at the upper end of the gun-bolt sleeve in Fig. 1 was previously produced by two or more hand-controlled machining operations. Now the complete cut is made in one automatic operation, and two bolt sleeves are finished simultaneously by the use of a Taylor & Fenn duplex spline milling machine modified to suit the job.

The time needed to mill the cam path in each bolt sleeve has thus been reduced from approximately four minutes to fifteen seconds. Manual control of the operation is eliminated, the operator merely being required to load and unload the work. Accuracy, uniformity, and surface finish have also been improved and the cost of machining has been substantially reduced.

Basically, the standard spline milling machine consists of two opposed horizontal milling spindles with a reciprocating table between them. If a straight cut only were required on the work, this could, of course, be accomplished by simply feeding the table on which the bolt sleeves are mounted past end-mills rotating in the spindles. However, to produce the contoured portion of the cam path, it was necessary to alter the design of the machine so that the work-pieces could be given the required rotary motion relative to their horizontal movement.

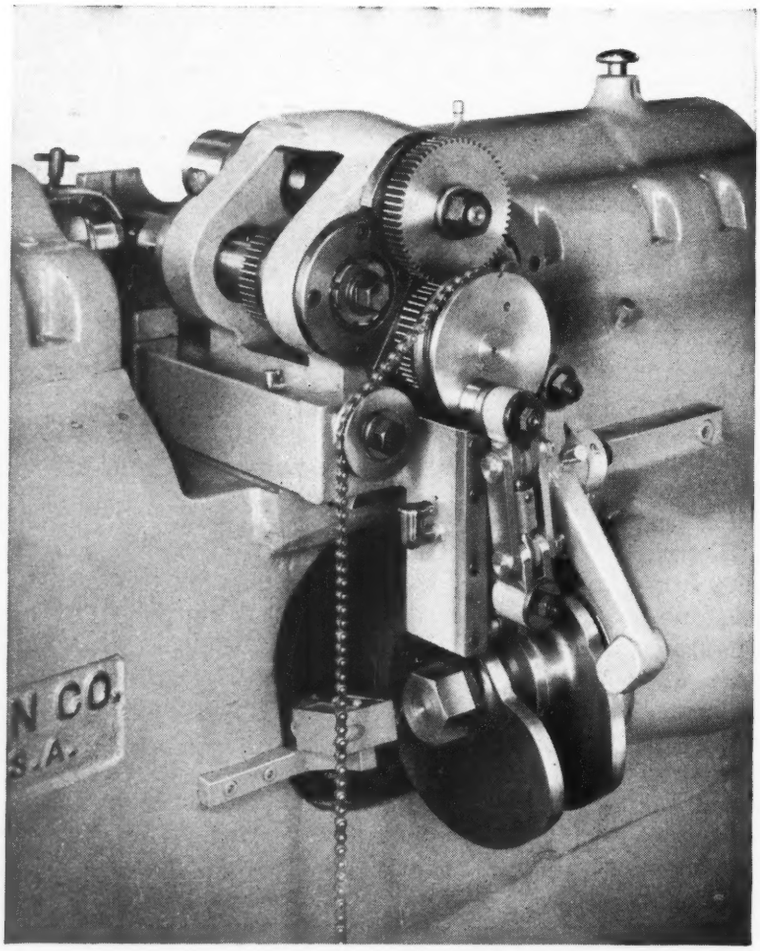


Fig. 2. Rear view of the cam-path milling machine, showing mechanism employed to reciprocate and rotate gun-bolt sleeves

The mechanism employed to secure the reciprocating and rotary motions is seen in Fig. 2, which is a rear view of the machine with the guards removed. The cam, follower, and lever at the lower right reciprocate the sliding table on which the work-holding fixtures are mounted. The second cam, located at the left of the table reciprocating cam, imparts rotation to the bolt sleeves by means of linkage and gearing in which provision has been made to eliminate backlash. Both of these cams merely provide the means of reciprocating and rotating the work-pieces, and do not control the accuracy and contour of the work.

The two work-holding fixtures *A*, Fig. 3, are mounted on tapered-nose spindles *B* and held in the outboard support *C*. Master cam *D* controls the accuracy and contour of the cuts by guiding bolt sleeves *E* as they are rotated and reciprocated past cutters *F*. Since the master cam is relieved of all actuating force, it is subject to little or no wear, thus insuring consistent accuracy and uniformity. Quick-acting manual clamps *G* need not be removed from the fixtures in order to insert the work-pieces.

The milling spindles are pre-set to the depth necessary for cutting through the thickness of the bolt-sleeve wall. After inserting the work-pieces in the fixtures, the clamps are tightened to locate and hold them in position. The operator then depresses the starting button, and the machine automatically completes the machining cycle. At the end of the cycle, the machine is automatically stopped by means of a micro-switch. The time cycle for an operation can be varied in order to obtain the degree of surface finish desired.

The part shown in Fig. 1 was completed with one pass of the cutter in thirty seconds, including handling time. Since two bolt sleeves are milled simultaneously, the time per piece is fifteen seconds. The spiral end-mills, 1/4 inch in diameter, used for the operation, are rotated at 2300 R.P.M., and the depth of cut is approximately 1/8 inch.

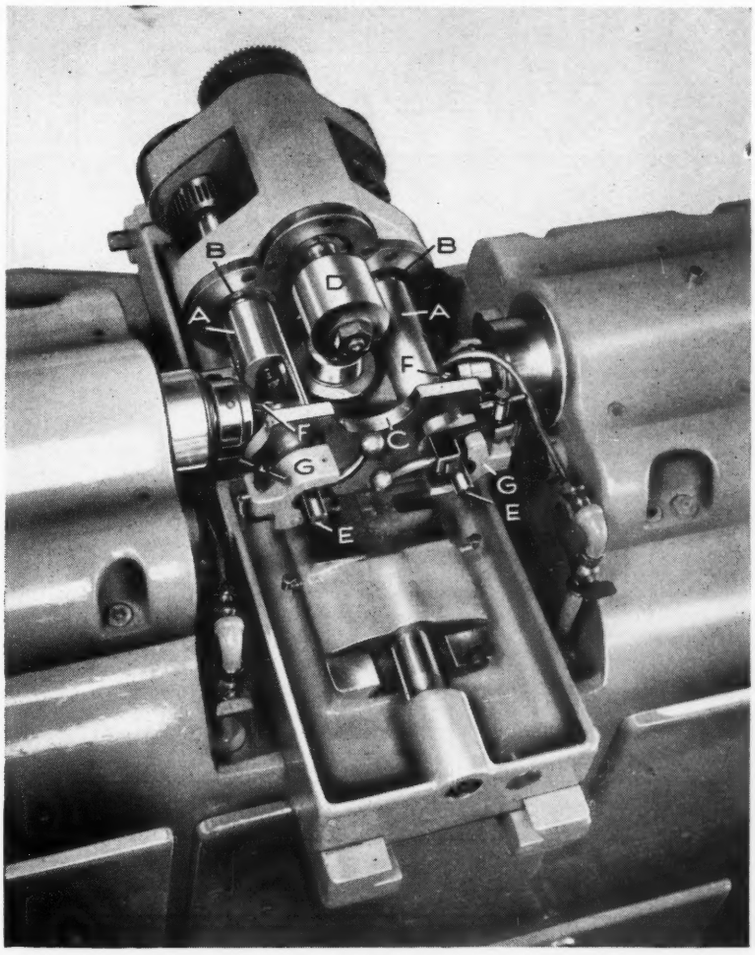


Fig. 3. Gun-bolt sleeves (E) are held in fixtures (A) while being rotated and reciprocated past end-mills (F). Two parts are milled in thirty seconds

* * *

Instrument for Measuring the Energy Expended by a Ship

How much energy a ship expends on a given trip can now be measured by an electric instrument called a "marine shaft horsepower-hour meter," which has been developed by the General Electric Co., Schenectady, N. Y. The meter indicates both the power being transmitted to the propellers at any instant and the total energy expended over a period of time.

The device consists of a small, self-contained unit which is mounted on the propeller shaft of the ship to measure the speed of the shaft and the amount of twisting to which it is subjected. The product of these two quantities, calculated automatically, gives the horsepower and, when multiplied by time, the total energy.

The instrument is expected to prove valuable in keeping a continuous check on the performance of the power plants of ships, enabling operators to select the most economical speeds, and indicating when the ships should be sent to the dry dock because of drag caused by fouled hulls.

* * *

Advance Registration Can be Made for the A.S.T.E. Exposition

Readers of MACHINERY who plan to attend the Industrial Cost-Cutting Exposition, which will be held in Philadelphia from April 10 to 14, inclusive, can make advance registrations, so as to avoid standing in long registration lines when they visit the show. An advance registration form is obtainable by writing to Harry E. Conrad, Executive Secretary, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

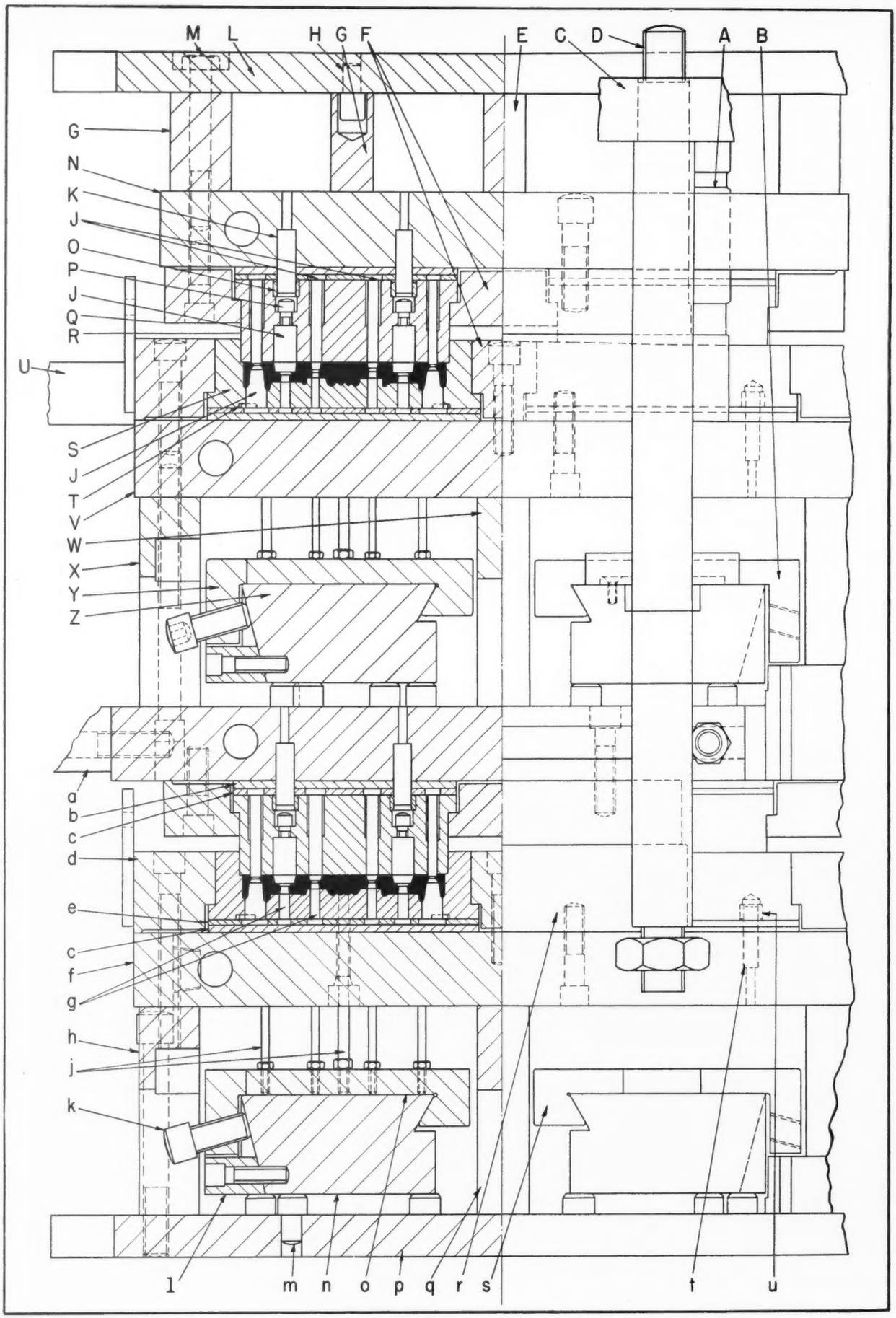


Fig. 1. Double-deck multiple-cavity compression mold for molding meter terminal blocks

Special Molds for Plastic Parts

Examples of Plastic Molds of Advanced Design, Including Double-Deck Molds and Plunger Type Transfer Molds — Last of a Series of Articles on Precision Molds for Molding Thermosetting Plastic Materials

By JOHN J. JOHNESCU
Assistant Superintendent, Tools and Plant Equipment
Switchgear and Control Division
Westinghouse Electric Corporation
East Pittsburgh, Pa.

SPECIAL types of molds are sometimes employed in molding plastic parts, either because of reduced mold or operating cost or because the design of the part makes necessary special mold construction. For example, under-cuts must be used on some parts, thereby requiring the use of a split-cavity mold; the part may be so heavy that a filler plate is required; or the production rate may be high enough to justify the design of a multi-deck mold.

Double-Deck Multiple-Cavity Mold

The outside terminal block of an electrical meter is produced in the complex mold shown in Figs. 1 and 2. This part, 4 7/8 inches long by 1 5/8 inches wide by approximately 1/2 inch thick, is ordered in lots of 250,000 or more, and therefore a fast acting multiple-cavity mold is required. The mold designed for this part is a double-deck compression mold, with fourteen cavities in each deck, twenty-eight parts being produced at each cycle of the press. The mold is mounted, with one deck above the other, in a standard Watson Stillman 142-ton press.

The sectional design, which can best be seen in Fig. 2, was selected for several reasons, the most important of which was the fact that the cavities could be hobbed, thereby effecting a considerable saving in the cost of manufacturing

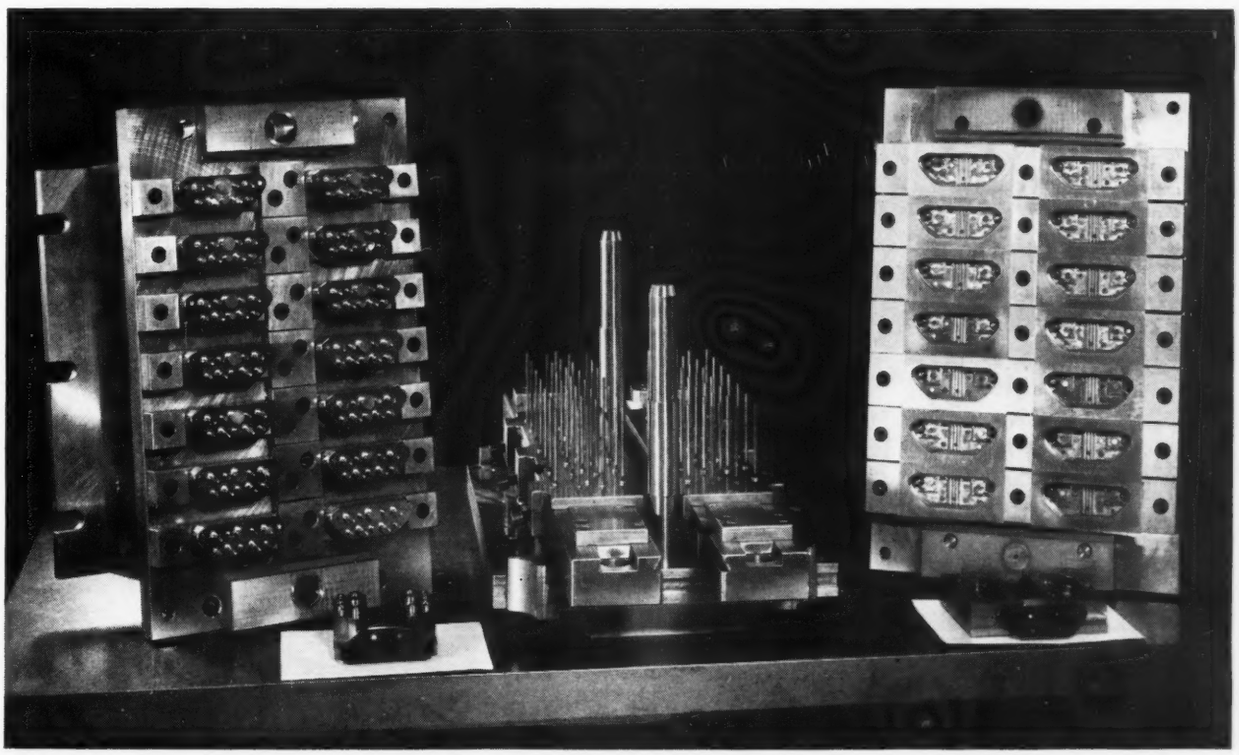


Fig. 2. Principal parts of one pair of molds for the double-deck mold illustrated in Fig. 1. Note the sectional construction of this unit

the mold. After the hob was machined, all twenty-eight cavities, plus several replacement cavities, were hobbed. Another reason for using a sectional mold was that such a unit, if damaged in the press, could be repaired by replacing one or two of the sections. While a mold machined from solid stock can be reworked if the damage is not extensive, it is much more difficult to do so. Also, worn cavities in a sectional mold can be replaced with less loss of production time than would be required to repair a worn solid mold.

The stripper also is constructed in two parts, as shown at *X* and *Y* in Fig. 1. In case of damage to one of the stripper pins *j*, the cap-screws through the stripper locating block *l* are removed, the cap-screws *k* loosened, and the stripper bar *Z* removed from the assembly. It is then a simple matter to replace the broken stripper pin.

The two molds are linked together so that, as the plunger moves downward, the top plate *U* is lowered, along with the bottom die *S* of the upper mold. The travel of the middle member is limited by a stop, the bottom member of the upper mold continuing its travel until it rests against the bottom mold. The upper press blocks *R* are then lowered until they are in the molding position. Further downward travel of the plunger causes pressure to be exerted on both the top and bottom molds, and the part is molded.

On completion of the molding cycle, the top mounting plate *L* is pulled up by the press ram. The upper mold is then raised, and the bottom member of the upper mold is lifted free of the bottom mold by pull-rods *D*.

Close tolerances and accurate alignment of all parts are of the utmost importance in a mold of this type, since all cavities must be closed with equal pressure to insure consistency in the physical characteristics of the product. It is prac-

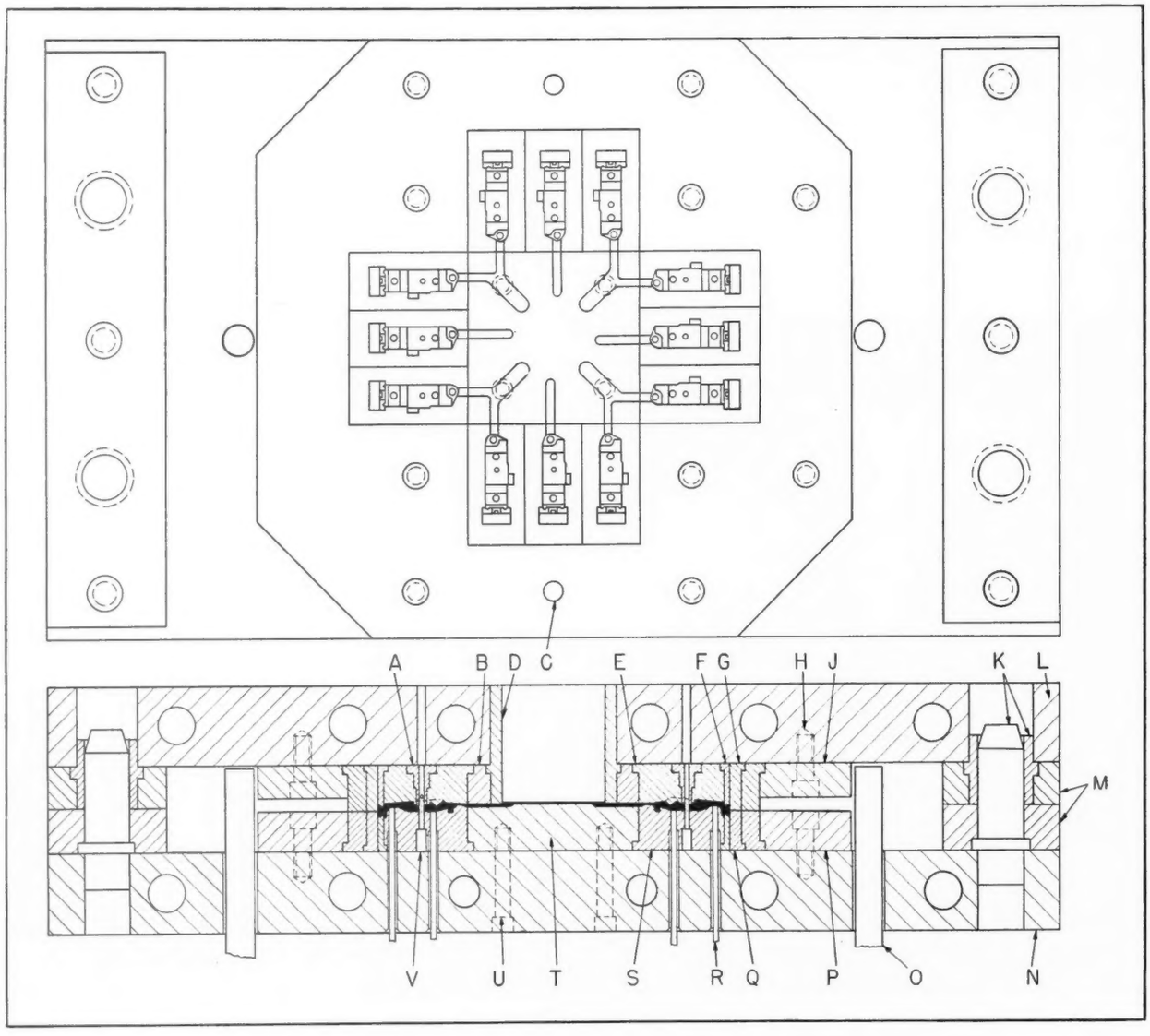


Fig. 3. Twelve-cavity plunger type transfer mold for molding circuit-breaker contact arms

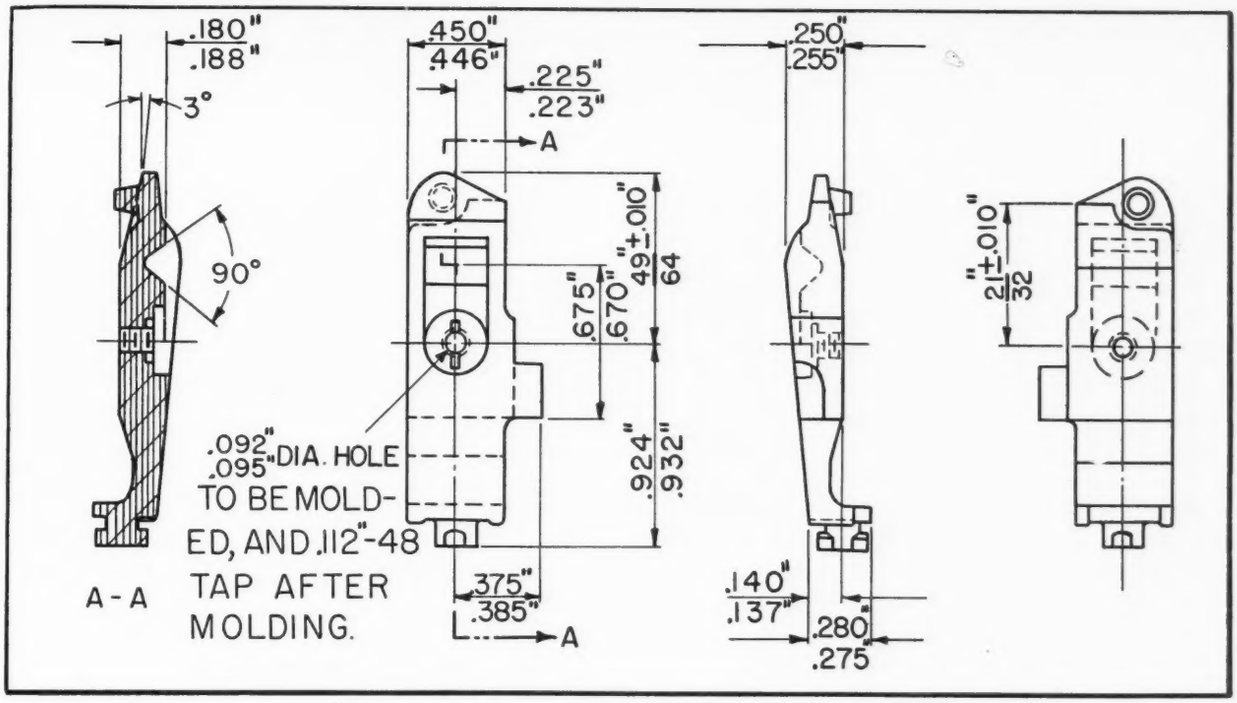


Fig. 4. These circuit-breaker contact arms are molded in a twelve-cavity plunger type transfer mold

tical only when production requirements are high enough and the estimated period of production is long enough to justify initial cost.

Plunger Type Transfer Mold

Another type of mold—one that has superseded the conventional sprue type transfer mold at the East Pittsburgh Works of the Westinghouse Electric Corporation—is shown in Fig. 3. This is a plunger type transfer mold designed for molding the circuit-breaker contact arm shown in Fig. 4.

Preformed plastic pellets are placed in the cavity formed by the plunger bushing *D*. The plunger is then lowered, forcing the plastic through the gates and into the mold cavities. The heat conducted to the cavities from the top and bottom steam plates *L* and *N* cures the parts. When the plunger is raised, the top die *E* and the top steam plate *L* are lifted off the pressure pads *M*, being guided in their travel by pins *K*. Stripper pins *R* then release the parts from the mold.

It will be noted that the mold is completely sectionalized, so as to permit the use of hobbed cavities and the ready replacement of worn or damaged parts. Inserts are used in both the top and bottom mold members wherever wear may be severe, as at *A* and *F*. If the inserts form a part of the mold cavity, as at *F*, hardened plates *G* are used to back them up.

Although this mold appears to be fairly simple in design, the close tolerances required on the work necessitate that extremely close tolerances be maintained on the mold members, especially since the mold is an assembled unit. Consequently, this is one of the most expensive designs in use at the present time, a fact that is not apparent unless the designer has had considerable experience in designing and building molds of comparable complexity. It is obvious that the need for close cooperation between the part designer, the mold designer, and the molder cannot be too srongly emphasized when units of this type are being developed.

* * *

Second Product Design Seminar Announced by Lehigh University

A second product design seminar has been announced by Lehigh University, in cooperation with the Society of Industrial Designers. The first seminar, which was given in the summer of 1949, proved so successful that a second four-week program (June 26 to July 21, 1950) has now been planned. The program will cover design policies, criteria, and aesthetics; consumer and market research techniques; psychological considerations in design; motion study as applied to design techniques; materials; fabrication techniques; design business procedure; staff and project organization; and contemporary design services. The seminar is open to representatives of manufacturing companies. For further information, write Robert F. Herrick, director public relations, Lehigh University, Bethlehem, Pa.

Engineering News

Gas-Shielded Welding of Stainless Steel and Aluminum Bronze

The Aircomatic inert-gas shielded metal arc-welding process, described in an article in the January, 1949, issue of MACHINERY as applied to the welding of aluminum, has now been successfully used to weld stainless steel and aluminum bronze. Briefly, this process, which was developed by the Air Reduction Sales Co., comprises the continuous feeding of a coiled wire electrode in a gaseous shield through the barrel of a welding gun. High-speed, continuous deposition of filler metal is possible in all positions of the work with a completely visible arc.

One of the specific advantages of the method in welding stainless steel is the small loss of alloying elements when the filler metal is carried across the arc and deposited in the weld. For example, 60 per cent of the titanium that may be present is transferred across the arc, making feasible the use of titanium-stabilized filler metal rather than columbium-stabilized metal.

This process also deposits more stainless steel at a given welding current, and hence minimizes heat effects in the base metal. While the welded surface is dull, it can easily be ground, buffed, or polished to any desired finish. The welds are sound—without porosity or slag inclusion.

Exceedingly high welding speeds are obtainable. In using 1/16-inch diameter wire, deposition rates of 15 pounds per arc-hour are possible in the down-hand position. In addition, there is no stopping to change electrodes and stub loss is eliminated. Since 3/8-inch thick square-edged plates can be welded without special edge preparation in only two passes, one from each side, there is a saving in overall fabrication costs.

Joint designs in heavy plates can be modified to have a small included angle because of the small diameter of the filler wire; as there is no trapped slag, the included angle may be reduced to 30 degrees. The diameters of wire available are 0.035, 0.045, and 1/16 inch in AISI Types 310, 316, and 347.

Welding aluminum plate in an upright position is easily accomplished by Aircomatic shielded-arc equipment. Argon or helium gas, fed to the gun, shields the molten aluminum from air and eliminates the need for fluxes, electrode coatings, and slag removal

Testing Bolted Joints under Fatigue Loads

Recent investigations at Northwestern University show that bolted connections or joints subjected to fully reversed cycles of fatigue loading may at times have unusually high fatigue strength. In one test program, joints were tested in a 250,000-pound capacity fatigue machine.

The 3/4-inch semi-finished bolts used in these joints were made from high tensile-strength 1038 steel, quenched and tempered to obtain a minimum yield strength of 85,000 pounds per square inch. Heavy semi-finished nuts and hardened washers, carburized to a depth of 0.030 inch, were employed. The main steel

plates were of 3/4- by 11 1/4-inch mild steel, and the strap plates of the half-butt joint were made from 3/8- by 11 1/4-inch mild steel. All holes were 13/16 inch in diameter, or 1/16 inch larger than the bolts.

The bolts were tightened with a torque wrench, and the actual clamping force and relaxation during testing were measured with a micrometer type extensometer. Additional tests were made with the main plate reduced to 3/8 inch thickness and four bolts instead of the eight or nine used in the main series of tests. The thinner plate was used in the second series to evaluate the effect of reducing the grip from 1 1/2 to 1 1/8 inches. By reducing the thickness of the main plate and the number of bolts, the ratio between the tension, shear, and bearing stress was changed from 1:0.57:0.89 to 1:0.64:1.80.

Before the fatigue tests were started, the individual bolts were carefully calibrated by torque-tension tests and load-total-elongation tests. A single joint specimen whose bolts were subjected to torque above the elastic limit was tested in tension. This specimen was placed in a 1,000,000 - pound Southwark - Emery Universal testing machine, and the slippage and elongation of the bolts were measured at each increase of load. Slippage occurred at 171,000 pounds. The clamping force at slippage was 235,800 pounds. A coefficient of friction of 0.36 was computed from the results of this tension test.

In assembling the specimens, the bolts were tightened, in general, to 75 per cent of their yield stress as determined by torque-tension loading. The bolts were subjected to a torque above their yield stress in two specimens and just below their yield stress in another specimen. No difference in the behavior or in the fatigue strength was found with the different amounts of clamping force.

Concentrating Equipment Facilitates Conversion of Low-Grade Iron Ore

Conversion of low-grade iron ore into satisfactory material for the making of steel requires concentration of the ore to increase the iron content before it is shipped to the blast furnace. This concentration decreases the cost of transportation and reduces the quantity of coke and limestone required in the blast furnace. The greatly increasing demand for steel and the growing use of lower grade ore have called for new concentrating equipment. Two types have recently been developed—an improved magnetic separator, now in operation, and a new type demagnetizer, to be placed in service shortly.

A large portion of the iron ore available in the United States is hematite, which is non-magnetic. To concentrate hematite-bearing ore magnetically, it must first be roasted to convert the hematite to magnetite, which is magnetic. The magnetic-bearing ore, mixed with water, is then transported to the new magnetic separator, which consists of a rotating drum enclosing stationary magnet coils in the lower portion. As the drum rotates, the magnetite is separated from the non-ferrous matter. This separator was developed jointly by the Jeffrey Mfg. Co. and the Westinghouse Electric Corporation. After magnetic separation, the magnetite must be demagnetized before it is fed to the classifier, which separates the finely ground material from the coarse.

Huge Compressors Will Cool Atomic Pile

Huge centrifugal compressors will be used to cool the atomic pile now being constructed at the Brookhaven National Laboratory, Brookhaven, N. Y. The steel wheels of the large blowers will revolve at a tip speed of 450 miles per hour, and move thousands of cubic feet of air and gases per minute. Each of the 12-foot high blowers is driven by a 1500-H.P. motor.

New Metal-to-Glass Seals for Electronic Applications

Many metals that a few years ago were unavailable in any great quantity are now becoming more and more common, and hundreds of new applications are being made. Two of these metals are zirconium and titanium. Among the many experiments being conducted are those by the Westinghouse Electric Corporation, at both the East Pittsburgh and Bloomfield Research Laboratories, in making metal-to-glass seals. Kovar has already proved successful in these seals, making possible many electronic applications previously not feasible.

Basically, the problem of sealing metal to glass is one of finding a metal and a glass of the same, or reasonably close, coefficient of thermal expansion over a wide temperature range. In the case of zirconium, two kinds of glass were close enough to it in expansion characteristics to warrant further investigation; with titanium, one type of lead glass matches the coefficient of expansion. Up to the present time, satisfactory seals for laboratory testing have been made with both of these metals. They produce gas-tight seals with a minimum of special precautions.

Preparing Shafts for Metallizing

By JOHN E. WAKEFIELD

CORRECT preparation of the base metal is the most important factor in successful spraying of metal on work. Two things must always be done—first, the surface must be cleaned thoroughly; and second, the surface must be roughened in such a way that there will be hooks and craters for the molten particles of sprayed metal to key into.

The first step in preparing a shaft for metallizing is to turn it down in a lathe to provide space for the metal to be sprayed on it. The amount of metal applied will depend on how much the shaft can be allowed to wear in service before replacement or rebuilding is again necessary. Obviously, the thickness of the sprayed metal must be such that wear will not cut through the coating.

Under-cutting ordinarily provides the clean surface mentioned as the first requirement to successful spraying. The proper depth of undercut for shafts 1 inch in diameter and smaller is the maximum allowable wear plus 0.010 inch; for shafts from 1 to 2 inches in diameter, the allowable wear plus 0.015 inch; for shafts 2 to 3 inches in diameter, the allowable wear plus 0.020 inch; for shafts 3 to 4 inches in diameter, the allowable wear plus 0.025 inch; for shafts 4 to 5 inches in diameter, the allowable wear plus 0.030 inch; for shafts 5 to 6 inches in diameter, the allowable wear plus 0.035 inch; and for shafts 6 inches and above in diameter, the allowable wear plus 0.040 inch.

The ends of the under-cut section should be dovetailed at an angle of about 20 degrees to provide end anchorages for the sprayed coating and also to insure a clean joint between the coating and the base metal. The dovetails should not be less than 1/8 inch from the end of the shaft surfaces.

Six Methods of Roughening Shafts prior to Metallizing

There are six methods of roughening shafts in preparation for metallizing, the oldest being to blast the shaft with G-16 or G-18 angular steel grit at a pressure of 80 to 100 pounds per square inch. Grit-blasting provides a good bond for soft metals, like zinc and aluminum, and it is therefore used extensively for anti-corrosion coatings of large area. A small shaft prepared in this manner is shown at *A*, Fig. 1, the section in the circle being magnified approximately five times to show the hooks and other irregularities clearly.

Steel-grit blasting is used to a limited extent, because, first, it provides only a fair bond with metals having a high melting point, such as steel. Second, the method involves considerable work handling, as the shaft must be turned in a lathe, then taken to the blast room for the roughening operation, and finally replaced in the lathe for spraying. Third, it is difficult to confine the blast to the undercut area of the shaft. Masking tape is

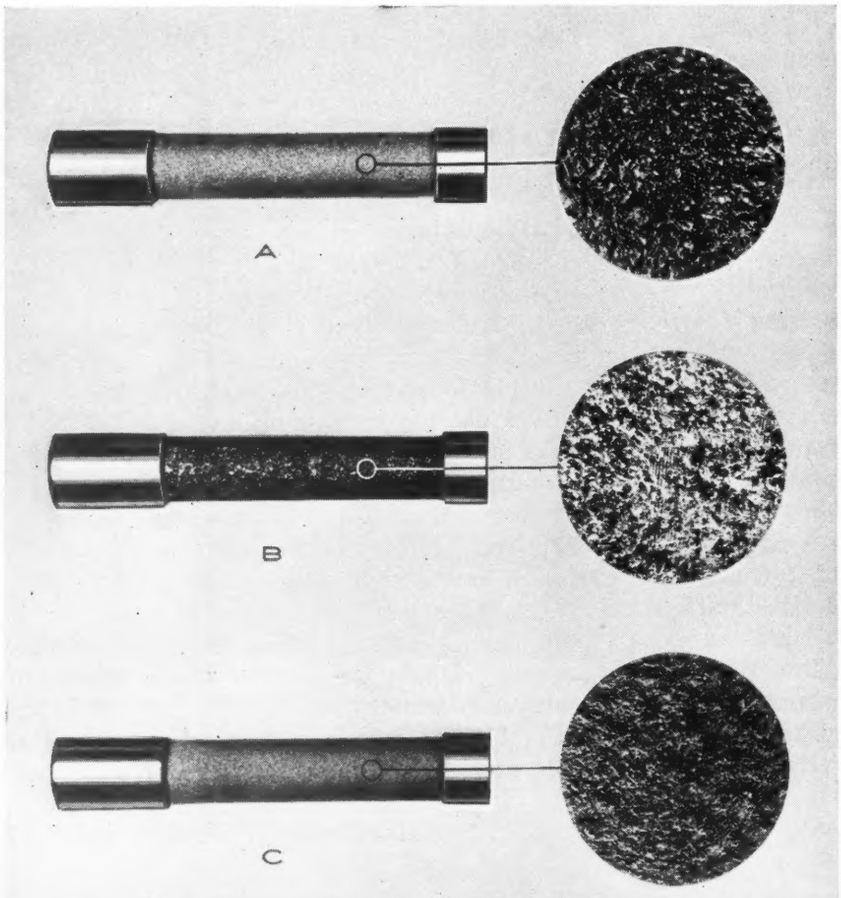


Fig. 1. Three shaft specimens prepared for metal spraying by grit-blasting, electrical bonding, and providing a self-bonding undercoat as shown at (A), (B), and (C)

generally used for this purpose, but the steel grit often cuts the tape and shaft shoulders, leaving a ragged joint between the sprayed metal and the parent metal. The method is, however, useful for surfaces that cannot be prepared mechanically, as in the case of some types of connecting-rod journals, and flat surfaces.

Roughening Shafts by Electrical Means

There are two fairly similar electrical methods of roughening shafts, rolls, etc. With both methods, an electrode of a special nickel alloy is brushed lightly over the surface, current being supplied by a generator. Electrical resistance heating causes the electrode metal to be simultaneously melted and firmly fused to the base metal. The heat penetration is slight—only about 0.005 inch. However, these methods should not be used on highly stressed parts, such as steam-turbine shafts.

Generators used for these roughening methods are made with several jacks into which two secondary cables can be plugged. One cable is connected to the electrode-holder and the other to a brush, which is mounted on the lathe toolpost to contact the work-shaft. Touching the shaft with the electrode completes the electrical circuit. Care must be taken not to permit the electrode to touch a lathe part, since all metal parts of the lathe are alive, with respect to the electrode, once the brush is in contact with the shaft.

Surface conditions ranging from fine to rough can be obtained simply by plugging the secondary cables into different jack combinations. The depth of deposited metal usually varies from 0.004 to 0.030 inch. Fig. 1 shows at *B* a shaft prepared with a combination of medium-voltage taps. For thin coatings of sprayed metal—under 0.025 inch—a finer surface condition is required, while for coatings 0.060 inch thick or greater, a coarser condition is necessary.

The most important point in electrical roughening is to cover at least 95 per cent of the area with the electrode material, as failures have occurred when not enough of the shaft surface was covered. In performing the operation in a lathe, the shaft should run at a surface speed of from 50 to 100 feet per minute. Several electrodes can be applied simultaneously, and bare spots can be touched up by hand with a single electrode after the lathe operation has been completed.

Electrical bonding was developed originally for surfaces too hard to machine. It is still useful for such work, as well as for narrow sections, such as lathe ways and gibs. A good bond is obtained along the edges of flat areas, where extra strength is required to prevent the coating from lifting due to shrinkage stresses. This method is often used on crankshaft connecting-rod journals instead of grit-blasting, but for ordinary work that can be prepared mechanically, the electrical method is usually too slow.

Self-Bonding Undercoat of Molybdenum Alloy

The newest roughing method is to apply a high-molybdenum alloy to the under-cut area. This material is sprayed on with an ordinary metallizing gun, and bonds itself firmly to smooth and even highly polished surfaces, provided they are perfectly cleaned. The molybdenum alloy bonds well to all common steels, stainless steels, Monel, nickel, chromium-nickel alloys, cast iron, cast steel, magnesium, and most aluminum alloys. It does not, however, bond well to copper, brass, bronze, chromium plate, or Duriron. At *C*, Fig. 1, is shown a shaft sprayed with the self-bonding alloy. The type of surface this method provides can be seen by the magnified view at the right.

This method is one of the most simple and rapid. An undercoat only 0.0015 to 0.002 inch thick is needed, and this amount can be sprayed in a short time. The self-bonding undercoat method is especially applicable in building up surfaces for fits under gears or bearing races when only a few thousandths of an inch increase in size is necessary. On such work, the surface can often be cleaned with emery cloth and the self-bonding material used for the entire build-up.

This method, however, is not suitable for flat surfaces or shafts having a keyway. It should not be used for coatings over 0.050 inch thick when there is an edge, and it should not be used for coatings of high-shrink metals, such as 0.10 carbon steel or 18-8 stainless steel, if the coatings are to be over 0.030 inch thick.

Rough-Threading for Metallizing Operations

All three of the methods described result in much stronger bonds when the surface to be sprayed is a full-depth V-thread of from 24 to 30 threads per inch. With threads, the effect of coating shrinkage stresses is minimized because they are confined to the narrow areas between the threads.

The earliest mechanical roughening method was to cut a torn thread in a lathe. With this method, the point of the tool is slightly rounded to avoid sharp lines in the base metal, and the tool is set slightly below the center of the work so that it tears the metal. From 14 to 30 threads are cut per inch, depending on the size of the shaft and the thickness of the coating to be

sprayed. Shafts of large diameter to which heavy coatings are to be applied should be provided with a coarse thread, as a general rule.

Fig. 2 shows at *D* a shaft prepared for metallizing by the thread-cutting method. The magnification shows the shredded appearance of the threads, with hooks and anchors for the particles of sprayed metal. This roughening method results in a fair bond on most steels and a very good bond on cast iron.

However, the application of this method is on the decline for two reasons: First, there are more positive methods of mechanical preparation, and second, some shop men object to this type of thread because of the danger of fracture lines at the bottom of the threads. Such danger is reduced if the tool point is lapped to a slight radius, but it still exists to some extent. The advantage of the method is that it is fast and relatively simple. Often under-cutting and threading can be done in a single pass across the surface. The author has never actually heard of cases where shafts prepared by this method have failed in service, but the method is not recommended for highly stressed parts.

Other Threading Methods

A preparation method that has consistently shown exceptional bond strength consists of grooving or threading and knurling. This method, known as the Metco, is a development of the Metallizing Engineering Co., Inc., Long Island City, N. Y. After under-cutting, the shaft is threaded with a square-nosed tool from 0.045 to 0.050 inch wide having its corners lapped to produce a slight radius at the bottom. Fourteen threads are cut to the inch on cast iron and sixteen threads per inch on most other metals.

After the shaft has been threaded, a knurling tool consisting of five circular saw-like blades, assembled with teeth staggered to take an irregular cut, is run lightly over the threads several times. The knurling tool roughens the threads and rolls their edges a little, leaving dovetails in each thread, as shown at *E*, Fig. 2. In spraying metal over a shaft prepared in this manner, the first few passes of the metallizing gun must be made with the gun held successively at right and left angles of about 45 degrees so as to fill in the grooves with metal and prevent bridging over.

This method is relatively slow, but no case has ever been reported where sprayed metal has pulled out of the grooves. It is recommended for shafts having keyways and for all cases where heavy coatings are necessary. It is also good for reciprocating shafts and rods.

Another mechanical method, which has recently gained prominence, consists of V-threading and knurling with a standard tool. In this method, which is named the Dennison after Peter G. Dennison, president of the American Metallizing Contractors Association, who developed it, a full 60-degree V-thread of 20 threads per inch is first cut to a depth of about 0.043 inch. Then a standard 90-degree knurling tool, 3/8 inch wide by 7/8 inch in diameter, having 20 teeth per inch is passed over the threads. The knurling teeth are fed into the threads to a depth of about 0.015 inch. This method produces hook-shaped anchors which are regularly spaced, both circumferentially and longitudinally.

There are several other methods of surface preparation which combine two or more of the methods already described, as, for example, V-threading and knurling,

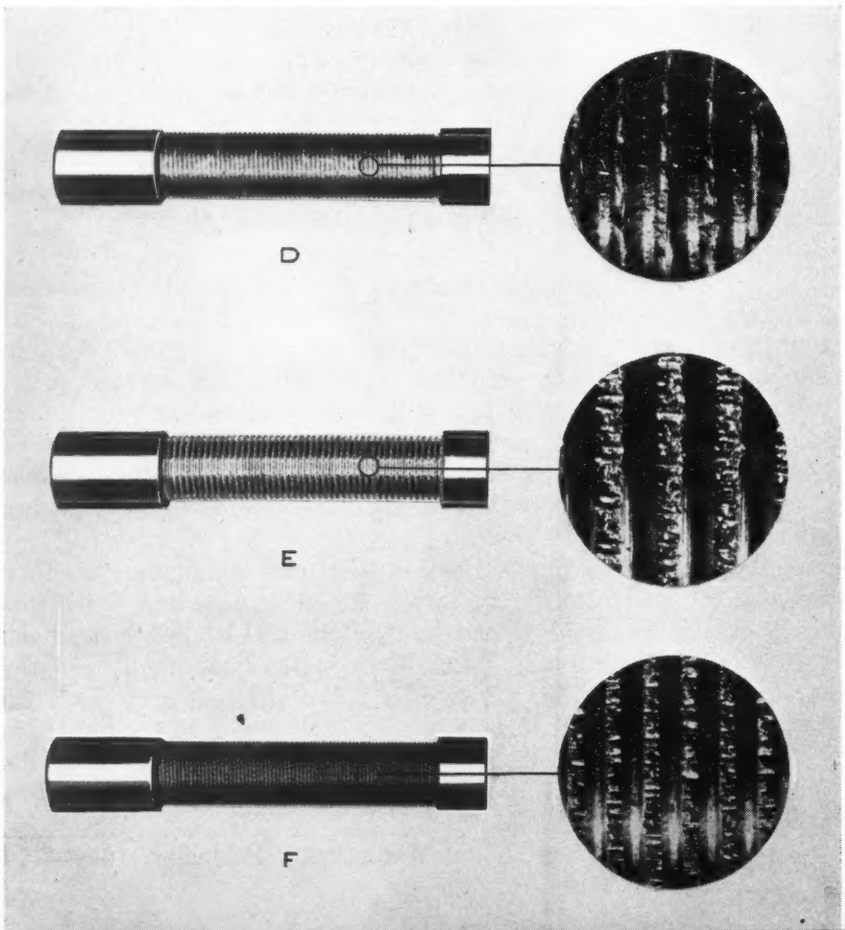


Fig. 2. Shaft specimens prepared for metal spraying by providing a rough-cut thread (D); cutting a groove with a square-nosed tool and then knurling with a special Metco tool (E); and cutting a V-thread of 24 to 30 threads per inch, followed by knurling with special tool used in Metco method (F)

V-threading and electrical depositing, and V-threading plus a self-bonding undercoat. In all of these, the first step is to cut a V-thread of from 24 to 30 threads per inch. In V-threading and knurling, the thread can be knurled by either the Dennison or Metco method. A surface prepared by the Metco method in combination with threads of narrow pitch is illustrated at *F*, Fig. 2.

Any of the combination methods produces a bond strength that is satisfactory for all but the thickest coatings and heaviest loads. The electrical method employed in combination with V-threading produces a stronger bond when applied over a thread than it does on a straight cylindrical surface. Hooks and dovetails are formed as the electrode bonds to the tops of the threads. The electrical method is much faster under these circumstances than when used on a straight cylindrical surface because the deposit does not need to be made over as great a surface area.

Similarly, the self-bonding undercoat creates a stronger bond when sprayed over threads than it does on a smooth surface. The threads interrupt the shrinkage stresses and increase the bonding area considerably. This method is one of the simplest and fastest, and appears to be the most practical for ordinary work.

Bond Strengths

Considering relative bond strengths, there are two things to be noted. In the first place, external loads are seldom applied to shafts in such a way as to cause bond failure. Therefore, the main consideration is to counteract shrinkage stresses in the coating. The accompanying table shows typical bond strengths obtained with the different bonding methods when carbon steel was sprayed on cold shafts. Unfortunately, tests were not conducted on the Dennison method, and so figures of separation stresses on parts treated by that method cannot be included.

Factors to be Considered in Selecting the Bonding Method

There are four main factors that influence the selection of a preparation method for a particular shaft as follows: The base material, the service to which the part will be subjected, the coating metal, and the thickness of the coating. The bond strength varies with the type of metal base. For example, on cold-finished steel, values such as those shown in the table are obtainable, but in the case of alloy steels hardened to 52 Rockwell C or higher, the steels cannot be threaded or grooved, and so the preparation

Separation Stresses of Sprayed Metal with Different Bonding Methods

Method of Surface Preparation	Nature of Test	Separation Stress, Pounds per Square Inch (Average)
Metco method	Shear	14,600
	Tension	4580
Grooving (24 V-threads per inch) and knurling	Shear	12,406
	Tension	4060
Electrical deposit, coarse, over grooved surface (24 V-threads per inch)	Shear	11,816
	Tension	3536
Self-bonding undercoat over a grooved surface (24 V-threads per inch)	Shear	16,000
	Tension	3050
Electrical deposit, coarse, on plain cylindrical surface	Shear	9386
	Tension	2480
Self-bonding undercoat	Shear	8850
	Tension	2150
Grit-blasting	Shear	6970
	Tension	2661

methods which require such operations are not suitable for hard steels.

Maximum bond strength is necessary in shaft applications when a coating 0.050 inch thick or greater is needed; when the shaft is subjected to a heavy load; when the shaft surface is interrupted by a keyway or a relief area; and when considerable wear is likely to occur. In all such cases, it is advisable to use one of the threading methods.

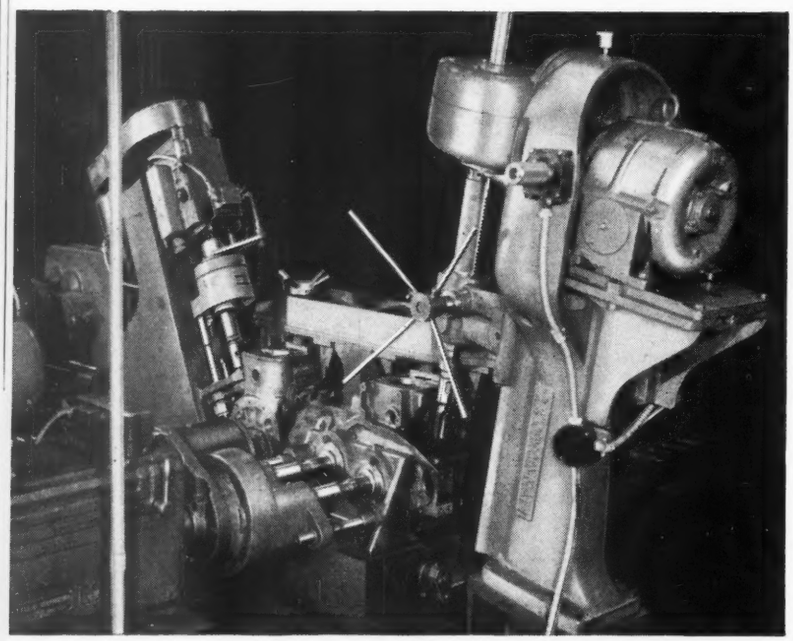
The shrinkage of sprayed metals varies greatly. For example, 0.10 per cent carbon steel shrinks 0.008 inch per inch, while 0.80 per cent carbon steel shrinks only 0.0014 inch per inch. The 18-8 type stainless steel has a high shrinkage, while the medium-chromium, medium-carbon types have a low shrinkage. Obviously, steels with a high shrinkage require a stronger bond than those that have a lower shrinkage.

The thicker the coating on a shaft, the more heat is produced in spraying and the higher the total shrinkage stresses. Coatings under 0.030 inch thick present no problem, regardless of the shrinkage characteristics. Maximum bond strength is needed whenever a heavy coating of high-shrink metal is to be sprayed. The strength of the bond can be reduced as the thickness of coating and the amount of shrinkage diminish.

* * *

Of the 624,500 workers in the steel industry at the middle of 1949, only 10 per cent were classified as unskilled labor. This was reflected in the average hourly wage—$1.68 in June, 1949.

Tooling Equipment Used in Making the Hercules Engine



By ROBERT MAWSON

Fig. 1. Tooling equipment used in machining cylinder blocks. Standard machines are employed in connection with a special work-holding fixture

SPECIAL tools and equipment are employed extensively in manufacturing automobile engines to insure the accuracy of duplicate parts and to reduce production costs. Some of the interesting fixtures and tooling equipment used by the Hercules Motor Corporation, Canton, Ohio, are described in the following.

Cylinder blocks are machined quickly and accurately by the set-up shown in Fig. 1, which consists of several standard machines arranged around a special fixture that locates and holds the work for facing, back-facing, reaming, and tapping. Another set-up for drilling various small holes at different angles in the cylinder blocks *A* is illustrated in Fig. 2. Eight air-operated drilling spindles are employed for this operation, which includes the drilling of oil-holes, camshaft bearing holes, etc. Part of the roller conveyor system used in this plant to transport work between machines may also be seen in this illustration.

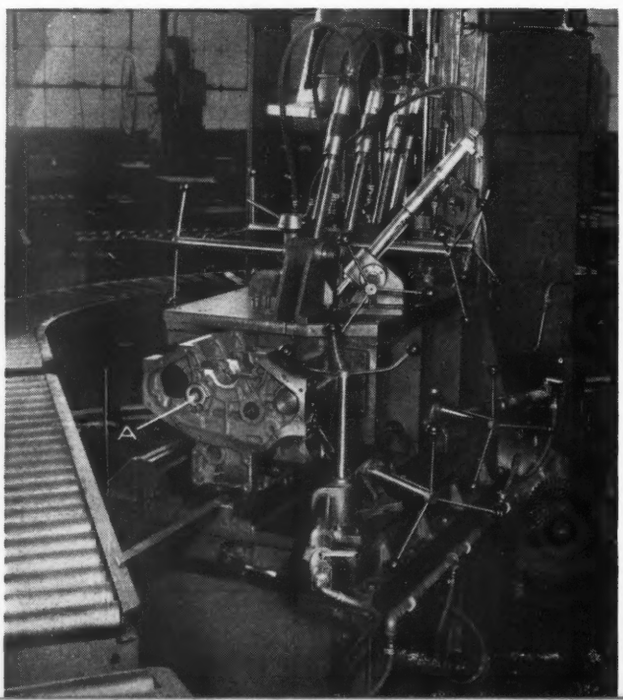


Fig. 2. Small holes are quickly drilled in cylinder blocks at various angles by the use of air-operated drilling spindles

The special fixture illustrated in Fig. 3 is used to locate and hold gear covers for a recess milling operation. The work *A* is accurately positioned in the fixture by means of hardened locating pins which engage reamed holes in the part. A cover *B* on the fixture is closed against the work and held in position by the latch *C*, after which a screw clamp *D* is tightened to hold the part in position for the milling operation. A positive stop controls the travel of the table when it is raised to bring the work up to the cutter.

A high degree of accuracy is required in the machining of connecting-rods in order to meet operating requirements. For this reason, a preliminary machining operation is performed in which a hole is drilled and two surfaces are milled for locating purposes in subsequent machining operations. The fixture illustrated in Fig. 4 is used for these operations. The small end of the connecting-rod *A* is located and clamped in the fixture against a fixed hardened steel block by means of a movable block, which

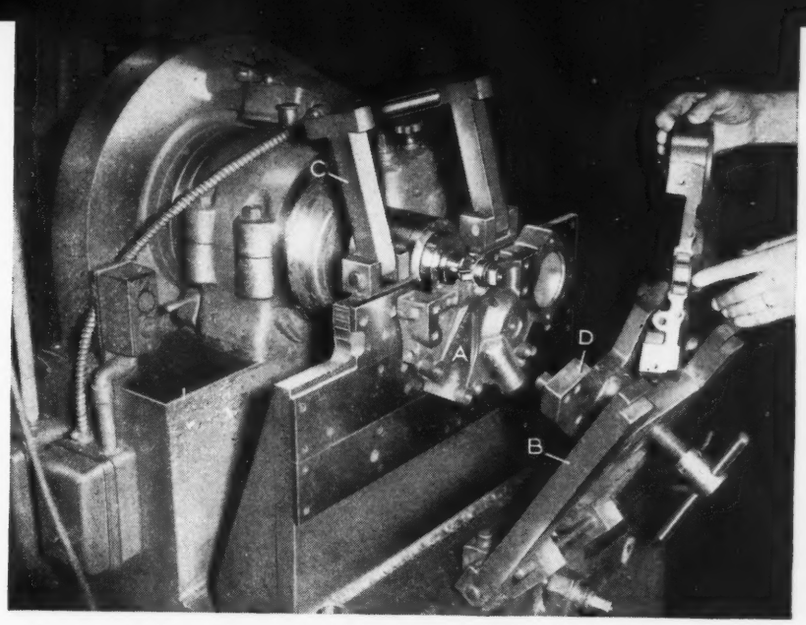


Fig. 3. Special fixture employed for quickly and securely holding gear covers while performing a recess milling operation

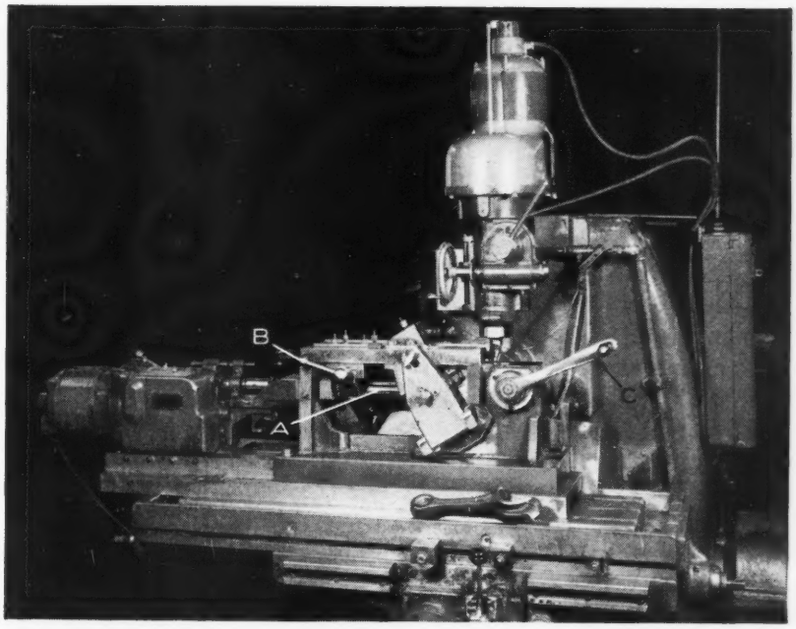


Fig. 4. Fixture used in milling and drilling locating surfaces on connecting-rods to facilitate subsequent machining operations

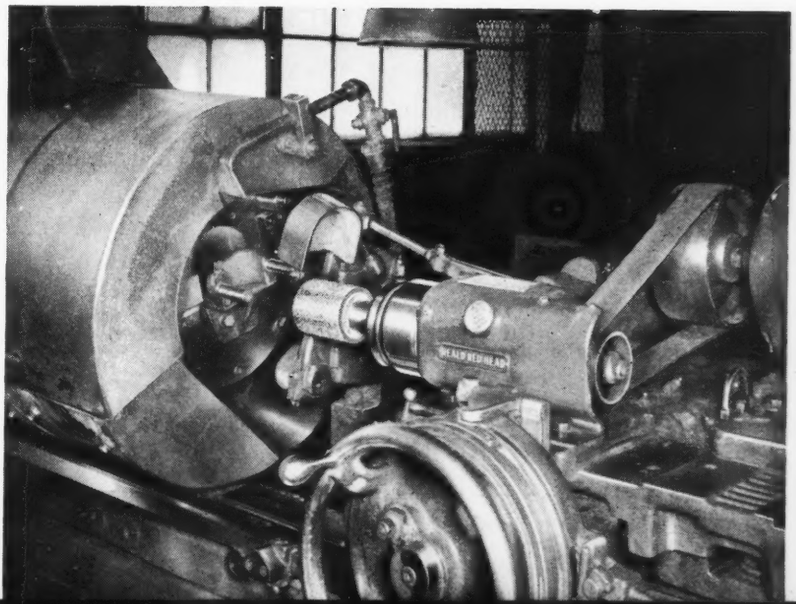


Fig. 5. Set-up for grinding the periphery of bolts and the cap attaching surfaces of integral-bolt type connecting-rods

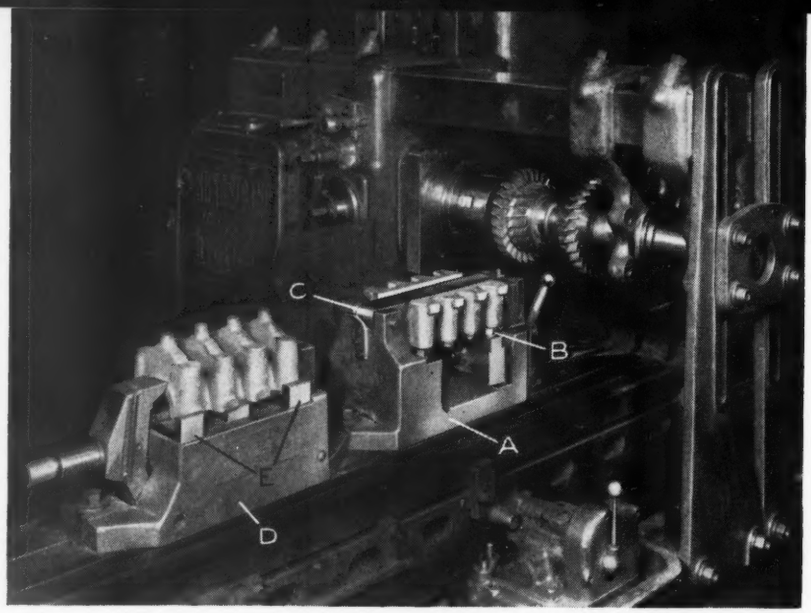


Fig. 6. Two milling fixtures used on a machine equipped with stepped milling cutters speed up the machining of main-bearing caps

has an operating handle *B*. A similar arrangement is used to locate and clamp the large end of the part, the operating handle for the clamp at this end being indicated at *C*. After the connecting-rod has been located and clamped securely, the side and a spot at the crankshaft end are milled and a hole is center-drilled at the wrist-pin end.

A fixture used for grinding the integral-bolt type of connecting-rods may be seen in Fig. 5. The work is located in this fixture by a pointed, hardened tool-steel pin that can be adjusted and fastened when in the correct position. A screw, also hardened and pointed, forces the connecting-rod against the pin, and a clamp is tightened at the outer end of the rod to secure it against a locator in the rear.

One of the cap attaching surfaces and the periphery of the bolt in that section of the connecting-rod are ground, after which the fixture is indexed to repeat this operation on another cap attaching surface. A more accurate surface for attaching caps to the bolts is provided by this operation, which also removes tool marks from the bolt periphery that might result in flaws.

Another interesting set-up is the arrangement employed for milling main-bearing caps. The caps are cast in blocks of four, and are milled in the fixtures illustrated in Fig. 6. By using the stepped cutters shown, the work in fixture *A* is milled at the assembly faces and the ends are machined and chamfered. The top bolt bosses are milled in fixture *D* after the work has been located on the previously milled faces by blocks *E*. A fixed stop and a movable clamp which is screwed against the work hold the parts in position in this fixture.

In fixture *A*, the work rests on four pins *B*, and is positioned and clamped by a hinged bar *C* which has a contour similar to that of the bearing hole in the casting. This bar is tightened by means of a swinging stud at one end of the fixture. After machining the work in this fixture, it is transferred to fixture *D* and a new casting placed in fixture *A*. Considerable machining and set-up time are saved by this arrangement.

A multiple-head drilling machine, six fixtures, and an indexing table are employed for drilling and reaming eight bolt-holes and rough-boring the crank-hole in the main-bearing caps. This arrangement is illustrated in Fig. 7, where it can be seen that four main-bearing cap castings are located on their milled surfaces. Four complete units are machined during each cycle of the machine. One of the advantages of this set-up is the elimination of a special boring machine.

Machine and tooling arrangements such as these are of considerable importance to the efficient production of modern automobile engines.

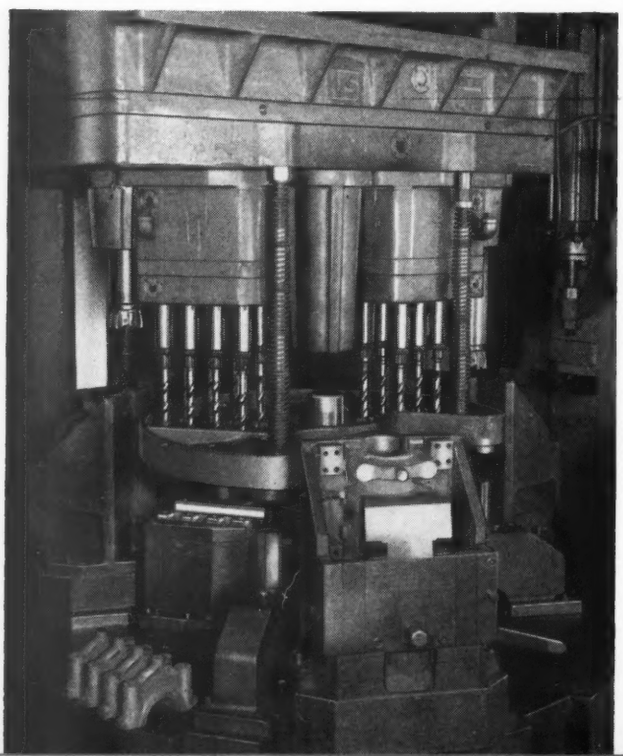


Fig. 7. A multiple-head drilling machine, together with an indexing table and six work-fixtures, is used for drilling, reaming, and boring main-bearing caps

Surface Fatigue Life Increased by Crowning

By R. HOWARD

THE phenomenon of fatigue failure, usually associated with machine components such as shafts subjected to alternating loads, normally occurs at regions of maximum stress concentration. Small radii, for example, may cause such concentrations, with consequent failures at stresses considerably below the nominal values obtained under conditions of steady loading. The cause of this type of failure is well known, and care is usually taken, in designing, to avoid sudden changes in section.

This procedure is followed, for example, in gear design, where the fillet radius at the root has a profound effect on the fatigue resistance of a gear tooth, which, in passing through a load zone, is subjected to bending stresses that alternate between zero and maximum values many times a second. While the root of the tooth, by reason of this loading, is subject to bending stress, the flank surface of the tooth is stressed in a different manner as the result of the contact loading.

When loads are transmitted by two curved surfaces, initial line contact is extended to a rectangle of an area depending on load intensity and relative radii of curvature of the members. This condition exists at the surfaces of gear teeth, rolls, the races of roller bearings, and rotary cams. The surfaces of all these components are subject to alternating loads as they pass through the load zone, and these alternating loads produce contact stresses. When stress concentration occurs, this loading may lead to surface, as distinct from bending, fatigue. Surface fatigue is characterized by the removal of small particles of metal, which is followed in some cases by final breakdown of the part.

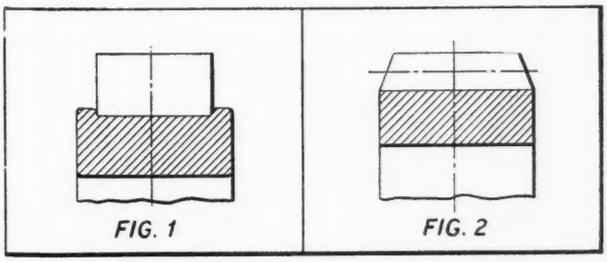


Fig. 1. Combined radial and lateral loads at the ends of bearing rollers induce stress concentrations higher than the stresses at the center. Fig. 2. Gear teeth are sometimes chamfered to improve surface fatigue resistance

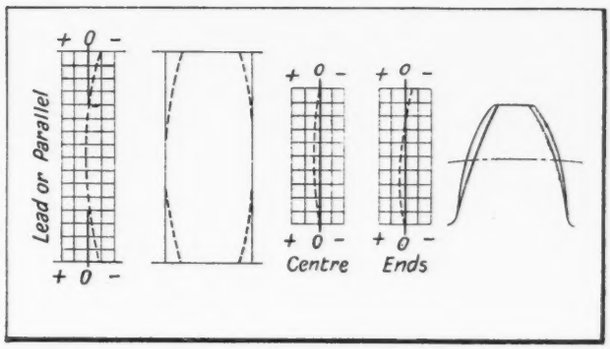


Fig. 3. Sectional forms of a crowned or "Elliptoid" gear tooth. At the left is a diagram of the horizontal profile thus modified, and at the right, a diagram of the vertical profile

In design, therefore, it is just as important to avoid the introduction of factors that will increase surface stress as it is to avoid other forms of stress, and this can be achieved by eliminating sudden changes in surface stress in the component.

Avoidance of such sudden changes requires, in general, the spreading of the load as evenly as possible across the contact area. Consideration should be given to this matter both in the design and in the manufacture of the various components.

Where line contact occurs between loaded members subjected to alternating stresses, the maximum stress concentration usually occurs at the ends of the contact area. With roller bearings, for example, work is being done at the ends of the rollers in compressing the material both radially and laterally (Fig. 1), whereas at the center portion only radial compression occurs. The combination of radial and lateral loads at the roller ends induces stresses as much as 50 per cent higher than the calculated mean contact stresses, and unless this stress concentration is avoided, fatigue failure will tend to occur over these areas.

With gear teeth, the bending stresses produce lateral strains, which are of significance only at the edges of the teeth, where the material is unsupported laterally. When plastic material is used for gears, it is common to support the tooth edges laterally by steel plates attached to the sides of the pinion or wheel.

There are other factors that tend to aggravate

the conditions of stress concentration at the ends of members, and of these perhaps the most important is shaft deflection. An evenly distributed load represents the desired operating condition, but this ideal is seldom achieved in practice. No shaft is entirely rigid, and under load, the resulting deflection tends to concentrate stresses toward one end of the load area. The amount of deflection, and consequent stress concentration, will depend on the applied load.

In many applications, where long line contact is involved, consideration must also be given to the inevitable lack of alignment permitted by manufacturing tolerances. Since deflection and misalignment are unavoidable, their effects must be allowed for, and the component so designed that the stress concentration under load is not unduly great.

As stress concentration takes place at the ends of the rollers in roller bearings, a more uniform stress distribution can be obtained under load by reducing the diameters of the rollers toward the ends. Similarly, by relieving gear teeth at the edges, not only is the surface fatigue resistance, but also the bending fatigue resistance, increased.

This tapering of a member toward the ends is known as "crowning," and is applied to roller bearings, cams, and gear teeth. An alternative procedure in the case of gear teeth is to chamfer the ends, as shown in Fig. 2, and this is especially important in single helical gears where tooth overhang occurs.

The amount of crowning is largely determined by practical considerations, and, with roller bearings, may be about 0.001 inch per inch of roller length for about 30 per cent of the length. With gears, 0.0003 inch per inch of face width is sufficient to avoid most stress concentration, while 0.0005 inch is the value generally used for automobile transmission gearing.

A common form of crowned tooth, known as the "Elliptoid," was developed and patented by the National Broach & Machine Co., Detroit, Mich. In this design, modifications are applied to both the horizontal and vertical profiles of the tooth, as shown in Fig. 3. The nature of the horizontal correction is indicated in the left-hand diagram. On the vertical profile, there is a positive correction of 0.0002 to 0.0003 inch at the pitch line. The involute form at the ends is also modified to avoid tip contact.

Crowning of Contact Surfaces

With roller bearings, crowning, which may be applied either to the rollers or the races, is achieved by a modification or extension of the conventional final grinding procedure. The modified profile required on gear teeth can be obtained by using a shaving machine with a crowning attachment which rocks the table as it is being reciprocated (Fig. 4). The rocking of the table causes the cutter to sink more deeply into the tooth flanks toward the ends of the teeth than at the center, the amount of crowning being controlled by the cam setting on the machine. The position of the crowning can be varied, so that where, for example, with an overhung pinion, the deflection under load can be calculated, the crown can be positioned to give the most satisfactory surface stress distribution.

With gears, crowning is usually the last machining operation prior to heat-treatment, and although tooth distortion inevitably occurs, even with careful quenching, its effect on the load distribution and stress concentration is far less serious than with teeth of parallel transverse section.

Fig. 4. Gear-shaving machine built by the National Broach & Machine Co., equipped with a crowning attachment to produce the modified profile on gear teeth

Test Results of Crowning to Increase Fatigue Life

The advantages of crowning in increasing the fatigue life of components subject to surface stresses have been demonstrated by many tests. For example, bearing rollers with a true radial crown, as distinct from end chamfer, have shown an increase in fatigue life of about 50 per cent. No spalling or pitting occurred at loads that led to failures of bearings having uncrowned parallel rollers, and with cam rollers similar results have been obtained.

Tests on motor vehicle transmission gears showed that, whereas straight gears failed within 85 hours at 140 pound-foot torque, similar gears with "Elliptoid" teeth (0.0005 inch crown) ran for 259 hours with a maximum torque of 160 pound-foot, and showed no indication of either surface deterioration or tooth failure due to bending fatigue.

* * *

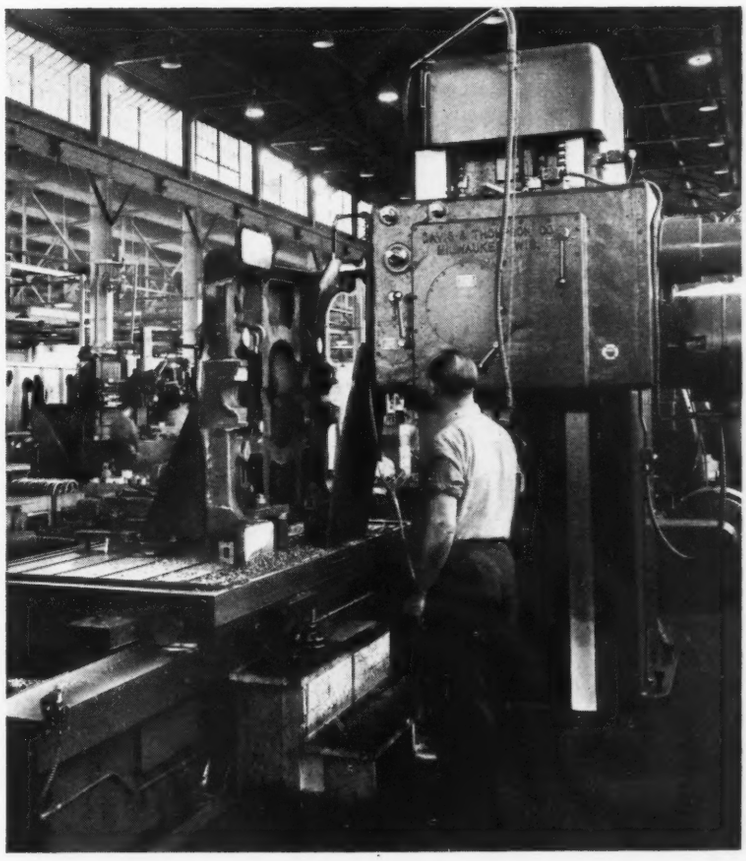
One automotive firm now uses an average of 1200 dies for each of its various makes of cars, or about 300 more per car than before the war.

Lincoln Electric Co. Erects New Plant

A preview of the Lincoln Electric Co.'s plant now being built by the Austin Co. in Euclid (Cleveland), Ohio, was held recently. The new plant will provide approximately twenty acres of floor space for the manufacture of welding machines and electrodes. Mechanically controlled lighting and ventilation will be provided in the windowless building. The functional lay-out of the plant will eliminate major material-handling problems, provide straight production lines, centralize all office operations, and furnish ample space for efficient factory operation and future expansion.

* * *

An "electronic torch," hot enough to cut holes in firebrick and to melt tungsten—hardest to melt of all the elements—has been developed by the General Electric Co. The torch is produced by the use of high-frequency radio waves in combination with certain gases, which results in temperatures considerably higher than the melting point of tungsten. The "heart" of the torch is an electron tube known as a "Magnetron." This development is still in the laboratory stage.



The machining time required to mill fourteen faces on the car body of a crane made by the Unit Crane & Shovel Corporation, Milwaukee Wis., has been cut to 2½ hours by means of the set-up illustrated. Previously these operations were performed on a standard planer, requiring from seven to eight hours to complete each part. The planer type milling machine shown was made by the Davis & Thompson Co. of Milwaukee

Cemented Carbides Used for Non-Cutting Applications

By J. S. GILLESPIE
Manager, Tool and Wear Parts Sales Engineering
Carboloy Company, Inc., Detroit, Mich.

THE properties characteristic of cemented carbides—high degree of hardness at both room and elevated temperatures, good wear resistance, exceptional rigidity, and ability to resist shock—give these materials advantages for use as machine parts, as well as for metal-cutting tools. In solid form, cemented carbide is being employed for many applications in addition to metal-cutting, several of which will be described in the following.

Solid carbide capstan rings, such as the one seen at *A* in Fig. 1, are used on wire-drawing machines. They effectively resist the wear caused by slippage of the wire, and outlast many steel rings. Since the capstan rings pull the wire through the drawing dies, any roughness on the ring surface will scuff the wire. Carbide rings stay smooth and insure a good finish on the wire. The wearing qualities of the die can also be increased by lining it with carbide.

The knurling of tough, corrosion-resistant steel proved such a severe operation that the knurling rolls had a life of only twelve to fifteen pieces. To avoid continual replacement and minimize scrap due to rapid tool wear, one manufacturer made knurling rolls from Carboloy Grade 44A bushing stock. A medium-pitch serration was ground into the carbide rolls with a diamond wheel to form the knurls. After being in continuous service for more than a year on a Warner & Swasey turret lathe, these carbide knurls were reported to be still in excellent condition.

Another manufacturer is using carbide knurls and pins, shown at *B*, for knurling fiber tubing. The fiber stock is used in making industrial electric fuses, and is so abrasive that the knurls and pins formerly used had to be replaced after knurling approximately 200 parts. Solid carbide knurls and pins are reported to have produced 41,000 pieces without showing visible signs of being grooved or worn.

Solid carbide grinding quills are being used for the precision finishing of the bores of such parts as collets and drill bushings. The stiffness of the carbide makes it possible to maintain close tolerances on deeper holes, and minimizes taper and chatter marks that sometimes result from flexing of the quill. Carbide quills reduce the finish-grinding time and make it possible to finish holes accurately having a length-to-diameter ratio of as much as 8 to 1.

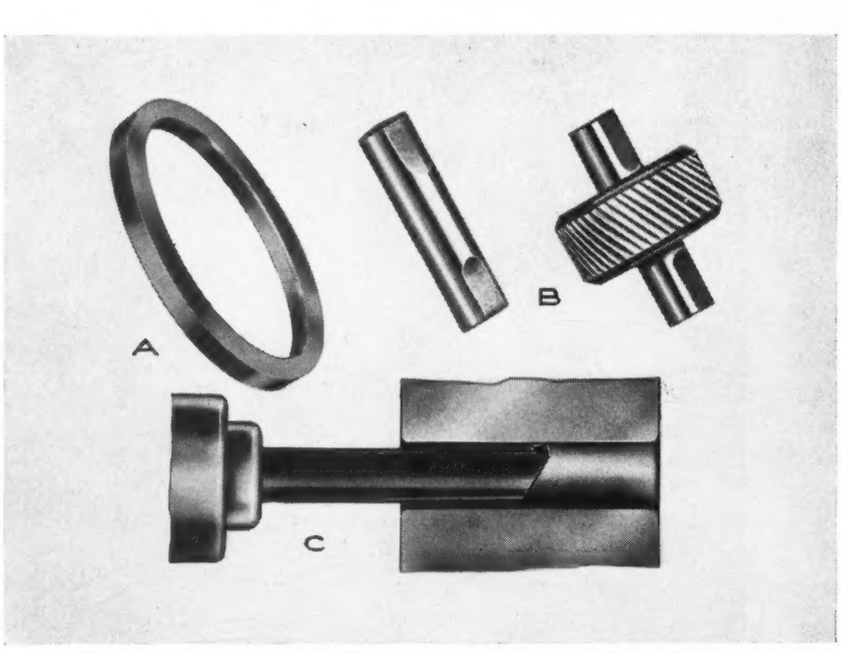


Fig. 1. Examples of parts made from solid carbide. (A), capstan ring for use on wire-drawing machines; (B), knurl pin and knurl employed for knurling fiber tubing; and (C), boring-bar for the precision boring of small, deep holes

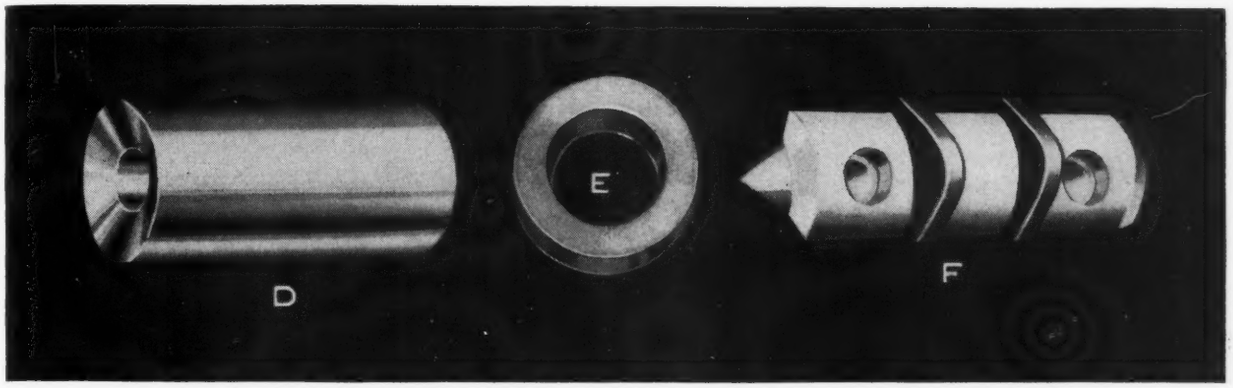


Fig. 2. A solid carbide die (D) is used for applying abrasive coatings to welding rods; a pump seal ring (E) combats excessive abrasion and erosion caused by sand and salt water; and carbide cams (F) function accurately without excessive wear

For the same reason, solid carbide boring-bars tipped with carbide, such as the one seen at *C*, are being used for the precision boring of deep holes. In such applications, the stiffness of the carbide keeps the bar from backing away from the work or "winding up" in the hole. Carbide-tipped boring-bars make possible the boring of straight, round, accurate holes having a length-to-diameter ratio as high as 6 to 1.

A solid carbide coating die employed in applying abrasive coatings to welding rod is shown at *D* in Fig. 2. In this application, the dies formerly used were subject to such rapid wear that they had to be scrapped approximately every two weeks. The use of a carbide die has reduced the wear, and the welding rod coating can now be applied without interrupting production frequently in order to change dies.

Pumps, such as those used for pumping sand-bearing ditch water to purifiers, and salt water aboard ships, are being equipped experimentally with seal rings of solid carbide to combat the high degree of abrasion and erosion caused by the sand and salt. Such a solid carbide seal ring is seen at *E*. Pumps of these types depend upon water for lubrication. Since a ship's pumps sometimes pump air when the ship rolls in a storm—as do the ditch-water pumps during ordinary operation—they are often without proper lubrication for appreciable periods of time.

This combination of abrasion, erosion, and lack of lubrication has proved so severe in the past that no material used for seal rings was satisfactory. The rings wore quickly and caused serious breakdowns. Carbide seal rings, however, are reported to keep their original high degree of finish and operate satisfactorily for thousands of hours without maintenance.

Another interesting and money-saving application of solid carbide parts is as protective stops on automatic machines, especially on machines where fine finishes and a high degree of accuracy must be maintained over long runs. Small pieces of solid carbide, usually low-cost standard tool tips, are attached to the stops. Also, carbide-tipped cams *F* have been found to function accurately and without wear on automatic machines. Such cams insure positive time cycles and minimize down time for repairs.

Wire stitchers and staplers for binding and stitching metal sheets, wooden crates, fiber board, cardboard, etc., with medium- and high-carbon steel wire are now being equipped with wire guides, cut-off quills and knives, and staple-forming tools all made from carbide. These carbide parts, in most cases, are brazed to steel shanks. It is claimed that the carbide parts last many times longer than previous steel parts, eliminating down time and loss of production, as well as materially reducing scrap.

Other applications of solid carbide include nozzles for making powdered milk, nozzles for spraying paints and insecticides, many types of thread guides for textile machines, piercing punches and small forming dies, extruding dies for the manufacture of ceramic insulators and radio parts, and burnishing rolls.

* * *

New Welding Patent Index

The Department of Welding Engineering at Ohio State University has announced the completion of a new patent classification index in the A. F. Davis Welding Library. This index makes it possible to obtain easily information concerning more than 12,000 United States patents on welding. Each patent is classified or indexed in several different ways—by process, material, product, use, name of the inventor, date of issue, etc., on a single card. These cards are sorted mechanically, enabling the numbers of the patents pertaining to a given field to be rapidly determined.

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

New Stainless Steel Suitable for Cold-Heading and Upsetting

A new chromium-nickel austenitic stainless steel, produced by the Carpenter Steel Co., Reading, Pa., has made practical the economical production of such stainless-steel parts as cold-headed bolts and recessed-head screws, cold-upset and punched nuts, and parts that require severe cold-coining and extrusion. An outstanding characteristic of this steel, known as Carpenter "Stainless No. 10," is that it work-hardens much more slowly than the conventional 18-8 types of stainless steel, and is, therefore, well suited to fabrication of fastenings and similar parts by drastic cold-heading or upsetting.

The composition of this steel is: Carbon, 0.08 per cent maximum; chromium, 16 per cent; and nickel, 18 per cent. Its corrosion resistance has been found to be as good as, or slightly better than, that of the conventional Types 302, 304, and 305. It resists a wide variety of organic and inorganic chemicals and foodstuffs.

This new stainless steel is being produced on a commercial scale in the forms of forging billets, hot-rolled bars and forgings, cold-drawn and ground bars, and wire and wire rods....201

Low-Temperature Alloy for Casting, Spraying, and Soldering

Cerrocast, a low-temperature alloy having negligible shrinkage and an extensive melting range, has recently been introduced on the market by the Cerro de Pasco Copper Corporation of New York City. This material is a non-eutectic alloy of bismuth and tin and has the following physical properties: Melting range, 281 to 338 degrees F.; yield temperature, 302 degrees F.; density, 0.296 pound per cubic inch; Brinell hardness, 22; and shrinkage, 0.0001 inch per inch.

Because of its wide melting range, this alloy can be coined readily to accurately reproduce the shape, dimensions, and fine surface details of a master pattern. It can also be used satisfactorily in spray guns and for low-temperature soldering of pre-tinned metal parts. 202

Tool Steel Developed for Hot-Working Operations

The Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., has developed a new tool steel which is specifically designed for hot work. Marketed under the name "B-47 hot work steel," this alloy is a combination of chromium, tungsten, cobalt, vanadium, and iron, which has proved in extensive laboratory and field tests to have excellent resistance to shock and abrasion at elevated temperatures. Although its good hot hardness permits the alloy to be used for any number of severe hot-work jobs without change of size, it is specifically recommended for applications that require good toughness at relatively high hardness or resistance to abrasion and heat checking.

This new steel is recommended for such applications as brass extrusion dummy blocks and dies, valve extrusion die inserts, forging die inserts, forging press dies, and hot punch tools. 203

Laminated Phenolic with Increased Strength and Machinability

The Synthane Corporation, Oaks, Pa., has announced a laminated phenolic material with exceptionally high impact fatigue values and superior machinability. These properties, which are obtained without sacrifice in electrical or chemical values, result from the use of a cotton mat filler, the fibers of which lie in random distribution within the laminations.

Average values of tensile, flexural, and compressive strength of the new Grade L-RF laminated phenolic considerably exceed the NEMA averages for Grades L and C. It is in the flatwise impact fatigue values, however, that Grade L-RF demonstrates its greatest superiority. Tests conducted by the Synthane Corporation, consisting of dropping a 1-pound weight from a height of 1 foot at the rate of 40 blows per minute on a notched impact specimen, showed that Grade L-RF resisted 5000 blows, as against 50 blows for Grade L and 100 blows for Grade C. The new grade phenolic can also be machined to a very smooth finish. 204

Ductile Cast Iron with Properties Approximating Cast Steel

A spheroidal cast iron, known as "Ductile Cecolloy," is now being produced by the Chambersburg Engineering Co., Chambersburg, Pa., under license from the International Nickel Co. The new material is displacing cast steel in many components of Chambersburg products, since it fills the gap that has heretofore existed between cast iron and cast steel.

In general, "Ductile Cecolloys" have many of the desirable properties of cast steel, yet retain most of the advantages of cast iron. These alloys which are produced to five different specifications, have almost the same shock dampening characteristics as cast iron, but their resistance to wear is well above that of both cast iron and cast steel. The wearing surfaces of the new alloys have a better backing, and induction hardening is practical. 205

Spatter-Proofing Compound that also Serves as Protective Coating

Parts and raw stock that require protection from rusting prior to welding and between metal-working operations can be treated with Protect-O-Metal No. 8, developed recently by G. W. Smith & Sons, Inc., 5400 Kemp Road, Dayton 3, Ohio. Applied by brush, spray, or dipping, it dries in less than an hour to a thin, transparent coating which prevents rust up to six months on steel exposed to the atmosphere, and up to two years on steel stored indoors.

The coating also prevents adhesion of all flash and weld spatter during welding operations and saves up to 85 per cent of the time required to clean welds. It will not cause porosity nor harm the weld in any way, and can be safely used on any metal surface. Protect-O-Metal No. 8 has been found suitable for protecting beveled plate edges from rusting prior to welding, as well as overlapped sections that are inaccessible for painting after welding. 206

Leak Detector for Use in Hydraulic Systems

A liquid leak detector known as "Trace" is now being introduced on the market for general use in hydraulic systems and closed liquid systems of all types by Highside Chemicals Co., 10 Colfax Ave., Clifton, N. J. The compound is red in color, and indicates the presence of either large or small leaks by depositing a red film at the point of leakage. Early indication of small leaks simplifies the testing of equipment and reduces field service after the equipment is installed. The compound is non-corrosive and remains active indefinitely.

The new leak detector is available in a high-grade lubricating oil medium for use in systems containing oil as well as in modified forms for systems employing aqueous liquids and chemicals of other types. It has already proved successful in brake assemblies, aircraft hydraulic controls, and refrigerating units. 207

Low-Carbon Stainless Steels Minimize Intergranular Corrosion

Low-carbon (0.03 per cent maximum) stainless steels are to be produced on a commercial basis by the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., according to a recent announcement. Up to the present time, it has been necessary to add columbium or titanium to austenitic stainless steels as stabilizers to minimize the adverse effects of carbon, and thereby render the alloy less susceptible to intergranular corrosion. As the supply of these elements is sometimes critical, conservation is served by avoiding their use unless absolutely necessary.

An extensive testing program has indicated that, on the basis of established standards, 18-8 stainless steels containing not more than 0.03 per cent carbon have a resistance to intergranular corrosion equivalent to that of 18-8 columbium and titanium stainless steels. Welding tests have confirmed these results, and have demonstrated that the low-carbon 18-8 materials can replace the stabilized types for applications that involve short heating times in the sensitizing temperature range. 208

Self-Lubricating Carbon Seal Resists Acid Corrosion

A self-lubricating mechanical seal, which is capable of withstanding corrosive chemicals and is particularly suitable for highly volatile fluids under high pressures, is now being manufactured by Morganite Inc., 3302 48th Ave., Long Island City, N. Y. These carbon seals are mechanically strong, immune to most chemical attack, and provide fool-proof sealing free from warping and gumming. They are self-lubricating during the life of the seal. This feature makes them particularly adaptable for installation in inaccessible locations. Morganite seals are suitable for use in pumps, agitators, mixers, and similar installations handling corrosive, volatile, or other liquids that are difficult to handle...209

Compound that Prevents Overspray Accumulation in Paint Booths

A material specifically designed for keeping walls and working surfaces of water-washed paint spray booths clean and free of overspray has recently been placed on the market by Oakite Products, Inc., 126 Thames St., New York 6, N. Y. This material, known as Oakite "Composition No. 45," is said to permit longer operation of paint spray booths between regularly scheduled maintenance cleaning by preventing the adherence of overspray to aprons, baffles, lines, and flood sheets of water-washed paint spray booths. It possesses the ability to float many of the organic coatings commonly employed. Other coatings are emulsified, and still others sludge out or settle to the bottom of the solution tank.

This compound may also be employed effectively for stripping organic finishes which adhere to paint racks, hooks, and similar spray booth equipment. 210

Dip Process for Brightening and Protecting Aluminum

Aluminum and its alloys, including those containing copper, as well as assemblies of alloys, can now be brightened and protected in a few minutes by means of simple immersions in aqueous solutions. These treatments also provide excellent bases for paints and lacquers. In many instances, fabricated parts can be put through this finishing sequence without prior polishing.

The mirror-like finish produced by this process, if followed by anodizing and coloring, will result in brilliant colored effects simulating brightly polished metals (gold, silver, copper, brass, chromium, etc.) or other colors. The corrosion resistance is said to be greater than on plated metals, and subsequent lacquering is not required. This process was developed by the Colonial Alloys Co., Philadelphia 29, Pa. ...211

Metal-Cleaning Abrasive with Improved Malleability

A softer, more malleable body, provided by a special treatment, is the feature of a new shot and grit for metal cleaning distributed under the trade name "Permabrasive." This product, announced by Hickman, Williams & Co., exclusive sales agents for the National Metal Abrasive Co., Cleveland, Ohio, retains its original impact value longer, so that its useful life is extended before final breakdown and less abrasion is caused on machines and parts. These characteristics are said to reduce bottleneck stoppages for repairs and assure a more continuous and efficient operation, with lower cleaning costs...212

Nickel-Silver Brazing Rod for General Application

A flux-coated nickel-silver brazing rod, designated All-State No. 11, for application with the oxy-acetylene blowpipe has recently been announced by All-State Welding Alloys Co., Inc., 273 Ferris Ave., White Plains, N. Y.

This new rod is described as intended for general utility use. Field tests on fourteen different metals have indicated its selection wherever bronze rod is normally considered. Superior performance has been demonstrated on steel, stainless steel, copper, copper-nickel, and nickel...213

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on these pages, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in February, 1950, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on the blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

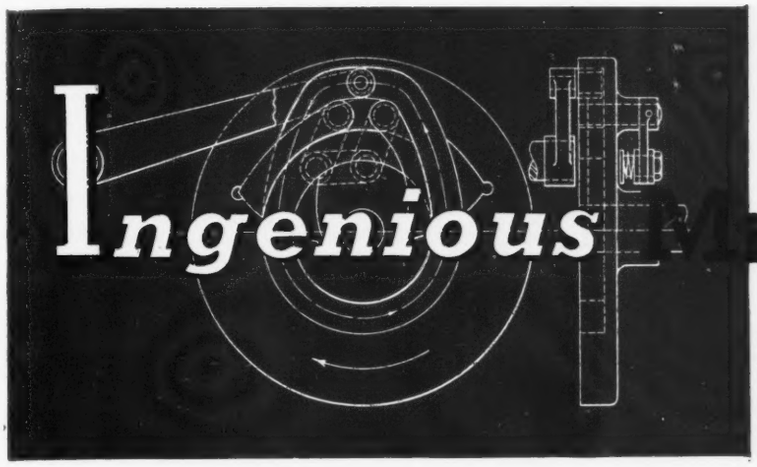
NAME..... **POSITION OR TITLE**.....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

FIRM.....

BUSINESS ADDRESS.....

CITY.....**STATE**.....



Ingenious MECHANISMS

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and other Devices

Roll-Actuated Clamping Device

Three interesting applications of an ingenious roll-actuated coupling developed in Germany are shown in the accompanying illustrations. The Stieber clamping device, as it is known, consists essentially of a cage containing cylindrical rollers arranged between the internal and external conical surfaces of the driving and driven members. The rollers are inclined at a slight angle to the axis of the conical members, so that when these members are pressed together and a tangential force applied to one, both members are securely clamped together.

In the application shown in Fig. 1, the chuck or flanged sleeve *B* is employed to grip the shaft *A*. Both shaft and sleeve have smooth cylindrical mating surfaces. The outside of sleeve *B* and the bore of clamping ring *C* are formed to the same taper. Between the two tapered surfaces are interposed the cylindrical rollers *D*, positioned in the cage *E* in such a way that their axes are inclined at an angle α to the horizontal axis of the device. When clamping ring *C* is turned in a clockwise direction, the slight inclination of the rollers results in an axial movement of the ring toward the flange. Consequently, the thin-walled sleeve *B* deflects elastically, and the hole is reduced in size so that the sleeve grips shaft *A* securely.

During the clamping action, only rolling friction must be overcome, with a coefficient of about 0.001. With slight tapers and slight inclination of the rollers, high pressures can be obtained, so that torque and axial forces up to the strength limit of the material can be reached.

The shaft is released by turning ring *C* in a counter-clockwise direction. Then the driving force is not transmitted through the rollers, but is transferred directly from sleeve *B* to shaft *A*,

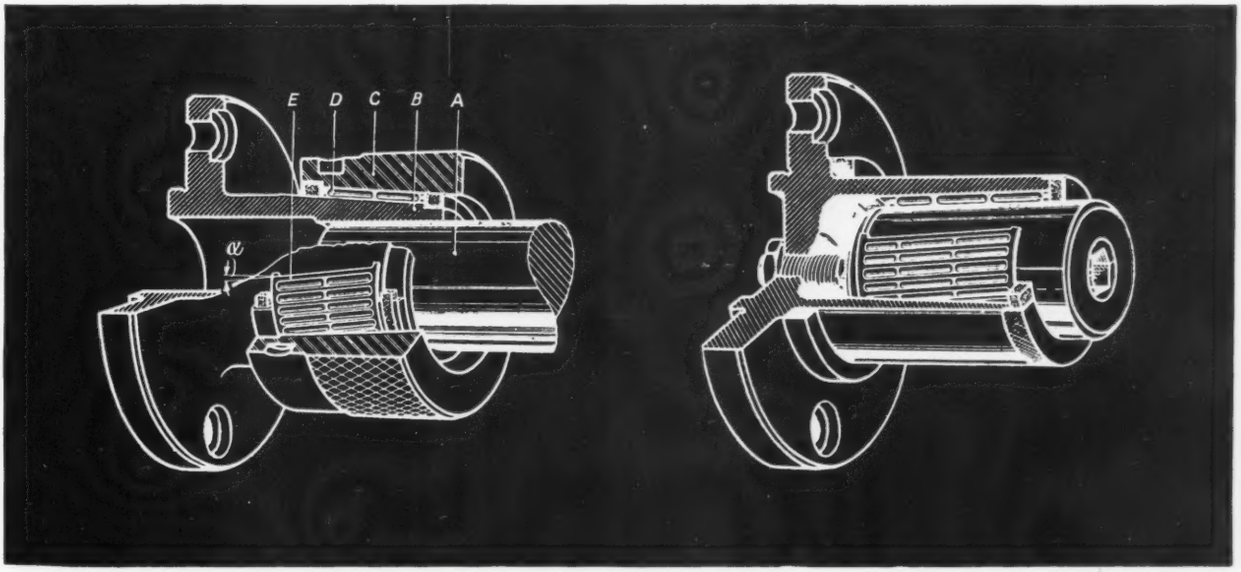


Fig. 1. (Left) Roll coupling employed for external clamping. Fig. 2. (Right) Roll coupling employed for internal clamping

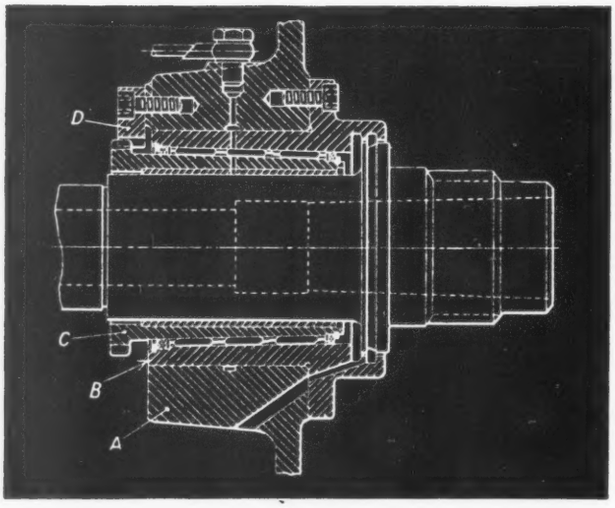


Fig. 3. Roll coupling used for fine adjustment of high-speed bearing

so that the grip is effective for both directions of rotation. Normally, a stop is provided to limit the movement of the clamping ring, and this controls the maximum pressure applied.

The arrangement shown in Fig. 2 provides an expanding mandrel for parts having smooth cylindrical bores, the tapered surfaces being provided in the bore of the mandrel sleeve and on the solid clamping member. In this case also, the rollers are retained in the cage at a slight angle, the clamping action being the same as for the application shown in Fig. 1, except that the pressure causes the mandrel sleeve to expand. The wall thickness of this sleeve is such that the section modulus is 0.5 to 0.75 times that of the solid shaft. The various components can be made in sizes suitable for the mounting of wheels and pulleys on grinding spindles.

Another interesting application of this principle is for adjusting machine tool bearings, as shown in Fig. 3. Here the machine housing *A* contains a steel bushing *B* with a taper bore. The bearing bushing *C* is correspondingly tapered on the outside and a cage with rollers is mounted between the two.

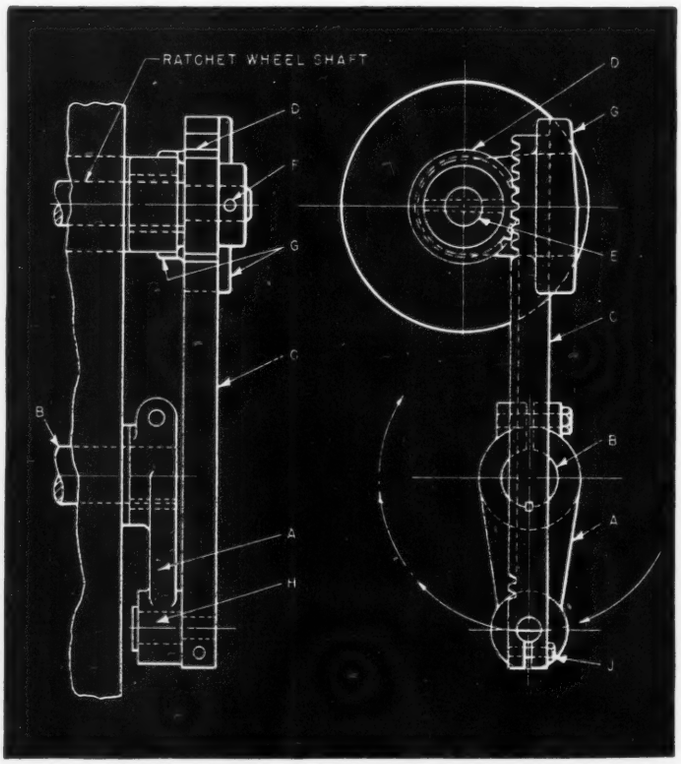
When bearing bushing *C* is rotated, the slight inclination of the rollers causes it to move in an axial direction, subjecting it to some radial deformation. In other words, the bore of the bushing is reduced or enlarged. To prevent accidental movement of the bearing bushing, it is provided with external teeth which are engaged by the locking member *D*. In this way, the bearing clearance can be accurately adjusted, and the clearance can be readily varied to suit different spindle speeds. Double bearings of the type described are employed on a finish-turning machine that is driven by a 1/2-H.P. motor running at 2800 R.P.M.

Intermittent Reversing Rotary Motion Produced by Rack Mechanism

By F. SERVER

A short lever *A*, attached to a shaft *B* in the mechanism illustrated, rotates continuously through a complete circle in the direction shown by the arrows. This imparts an up and down movement to the rack and at the same time oscillates it.

Rack *C* engages a gear *D*, pinned to the upper shaft *E* at *F* and held in contact with it by the yoke *G*, which is free to swing on shaft *E*. The engagement of the rack with the gear, and its sliding motion in the slotted yoke, imparts to shaft *E* a rotating movement first in one direction and then in the reverse direction. This action operates a ratchet and pawl mechanism within the machine. The ratchet drives a chain unit while revolving in one direction, and the drive is released when the mechanism is reversed. Rack *C* and lever *A* are connected by the shouldered stud *H*, and are held tight by means of the screw *J*.



Eccentric rack movement that drives shaft with intermittent reversing motion

Tool Engineering Ideas

Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

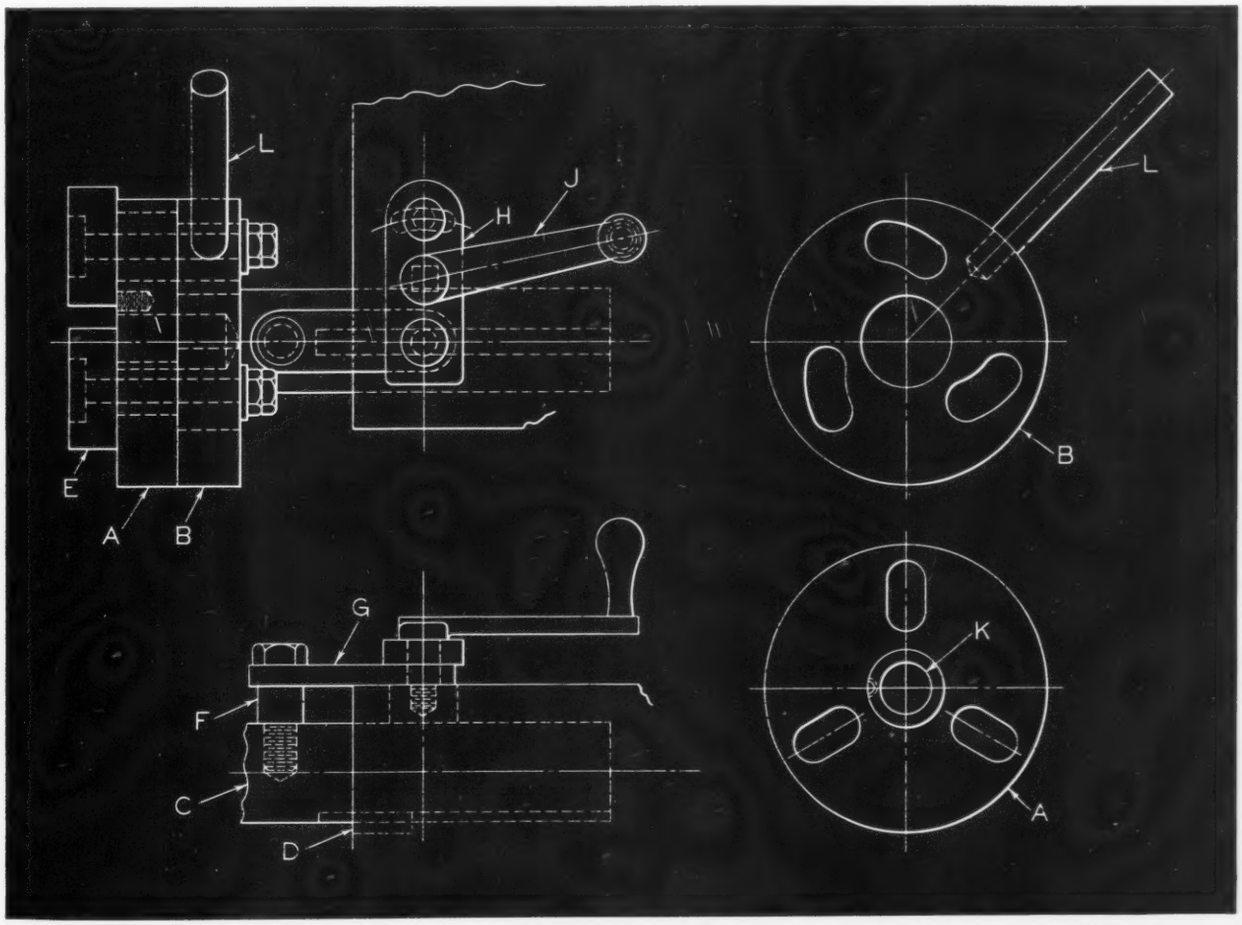
Tailstock Attachment for Supporting Lathe Work without Centers

By ROBERT MAWSON, Providence, R. I.

The attachment shown in the accompanying illustration is designed for use in place of the regular center of a lathe tailstock. The three equally spaced, hardened and ground steel rollers *E* of the attachment support one end of the shaft to be turned, while the jaws of the lathe chuck hold and drive the other end. The attachment was originally developed for turning operations on shafts that could not be made with countersunk edges for mounting between lathe centers in the conventional manner.

One end of the shaft to be machined is first gripped by the jaws of the chuck on the headstock spindle of the lathe. The attachment on the tailstock is then adjusted longitudinally by moving the lever *J* until rollers *E* are in the correct position for supporting the other end of the shaft. Next, the handle *L* is moved to bring the three rollers into contact with the shaft, so that it is accurately supported in a concentric position relative to the lathe spindle. Rollers *E* then serve as a bearing for the revolving shaft while it is being machined.

The construction of the attachment will be clear by referring to the illustration. The plate *A* is attached to shank *C*, which is a sliding fit in the bore of the tailstock. A key *D* in the bore



Attachment designed to support work at tailstock end of lathe when part is such that it cannot be provided with countersunk centers for mounting between centers

fits a keyway in shank *C* and prevents plate *A* and shank *C* from turning, while, at the same time, allowing these two assembled members to be adjusted longitudinally. The longitudinal adjustment is effected by lever *J*, acting through links *H* and *G*. One end of link *G* is attached to shank *C* by stud *F*, and the other end is attached to link *H*. There is a pin in the opposite end of link *H* that fits into a slot in the tailstock designed to keep the link properly positioned. The lever *J* and link *H* are mounted together on the square section of the pivot pin.

Rollers *E* are supported on pins that pass through the radial slots in plate *A* and also extend through cam slots in plate *B*. A lock-nut on each of the roller pins is adjusted to hold the rollers and plate *B* snugly against opposite sides of the stationary plate *A* and yet allow the rollers to move inward and outward when plate *B* is rotated by handle *L*. Rotation of plate *B* causes the cam slots to act on the roller pins and move the rollers in or out as required. Plate *B* is, of course, a turning fit on shank *C*. It will be noted that there is a counterbore in the end of shank *C*, which permits some variation in the length of the work held without moving the tailstock.

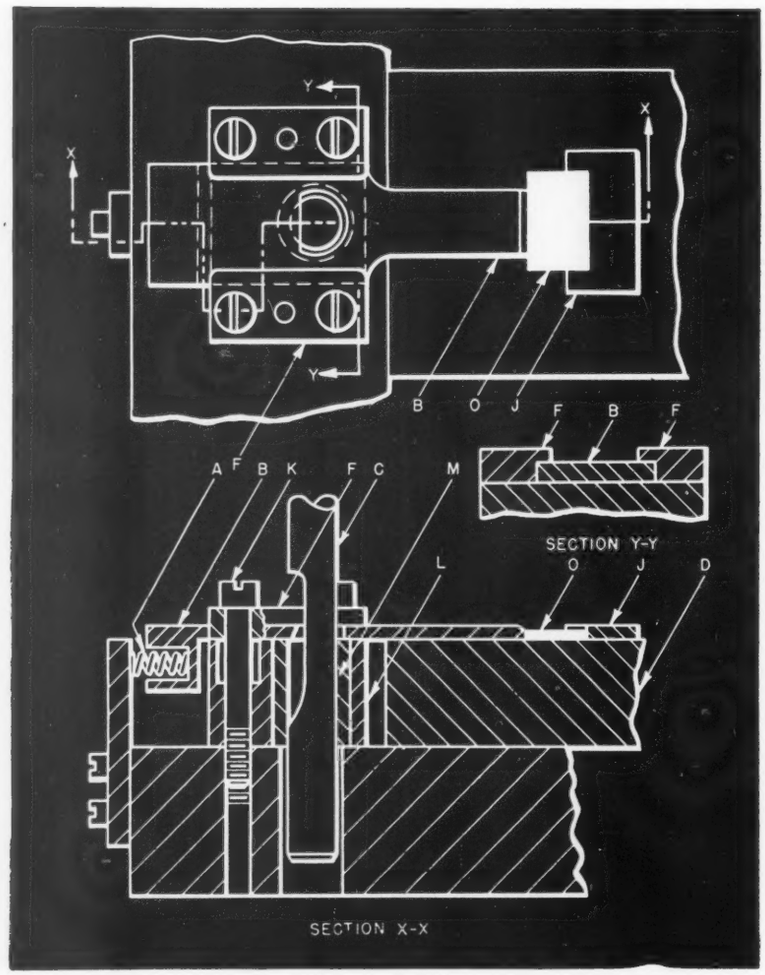
Automatic Clamp that Facilitates Loading and Unloading of Press

By CLIFF BOSSMANN, Dayton, Ohio

A device for automatically clamping work on the down stroke of a press ram and releasing it on the up stroke is shown in the accompanying illustration. Pin *C*, which is secured to the punch-holder, or upper half of the die-shoe, is shown in its lower position. During the downward motion of the ram, slide *B* is moved to the right by the action of spring *A*, thus clamping work-piece *O* in locator *J* while the operation is being performed.

On the up stroke of the ram, the cam surface at the lower end of the recess in pin *C* moves clamping slide *B* to the left, against the resistance of spring *A*, thus providing ample space for removing the finished part and loading another work-piece. Hardened and ground bushing *M* holds pin *C* in alignment, and retaining blocks *F* guide the clamping slide.

This design permits easy resharpening of die-block *D*. By simply removing spring *A*, slide *B*, retaining blocks *F*, and locator *J*, and screwing screws *K* down into the counterbored holes in soft block *L*, the top surfaces of die-block *D* and block *L* can be ground simultaneously.



Work-piece (O) is automatically clamped against locator (J) on the down stroke of the press ram by spring-actuated slide (B). On the up stroke, slide (B) is moved to the left by pin (C)

Simplified Method of Laying Out Progressive Dies

By FEDERICO STRASSER
Santiago, Chile

The simple method of laying out dies described in the following has often been found useful where precision equipment is not available. Although this method can be applied to more complicated progressive dies, the procedure to be followed in the case of a simple blanking and piercing die is outlined here for purposes of illustration.

When a part such as shown in the illustration is to be produced, the first step is to make up all the component parts of the die. This

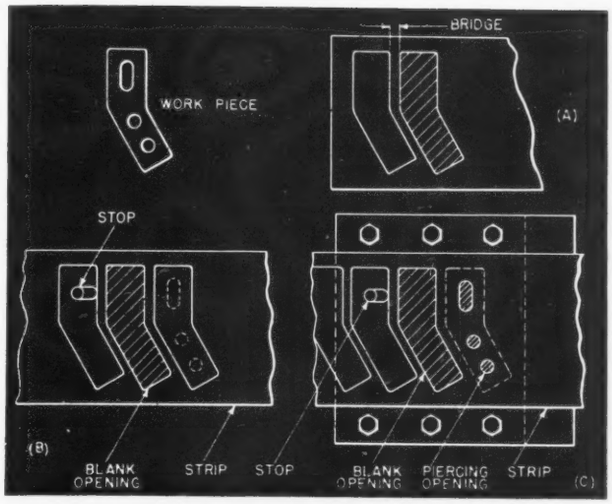


Diagram of procedure for laying out a two-station blanking and piercing die without the use of precision equipment

includes the punches, which may be hardened, the punch-holders, stock guides, stop, etc. The blanking station is constructed in the die, but the piercing station is omitted until its position is determined by the lay-out. The die is left soft for this purpose and clearance between the punch and the blanking station should be held to a minimum.

Using a strip of soft copper, 0.010 to 0.020 inch thick and of the same width as the actual stock, two adjacent blanks are made as shown at *A*. The bridge, or amount of stock left between the openings, depends largely upon the thickness of the material and the size and shape of the blank. Generally, this should be not less than 1/16 inch for stock up to 1/16 inch thick, and it is good practice to leave 3/32 to 1/8 inch between adjacent blanks for stock up to 1/8 inch thick.

The stop is then assembled in the die and its position adjusted, using the two blank openings in the copper strip to determine the location relative to the die opening. After this, three additional blanks are made in another portion of the copper strip. The strip is then placed on the die-block, as indicated at *B*, and aligned by inserting the punch in the die cavity through the second blank opening. The third blank opening is traced with a scriber on the die-block. Using this strip to check the accuracy of the work as it progresses, the piercing holes are located inside the outline, as shown at *C*, and machined in the die.

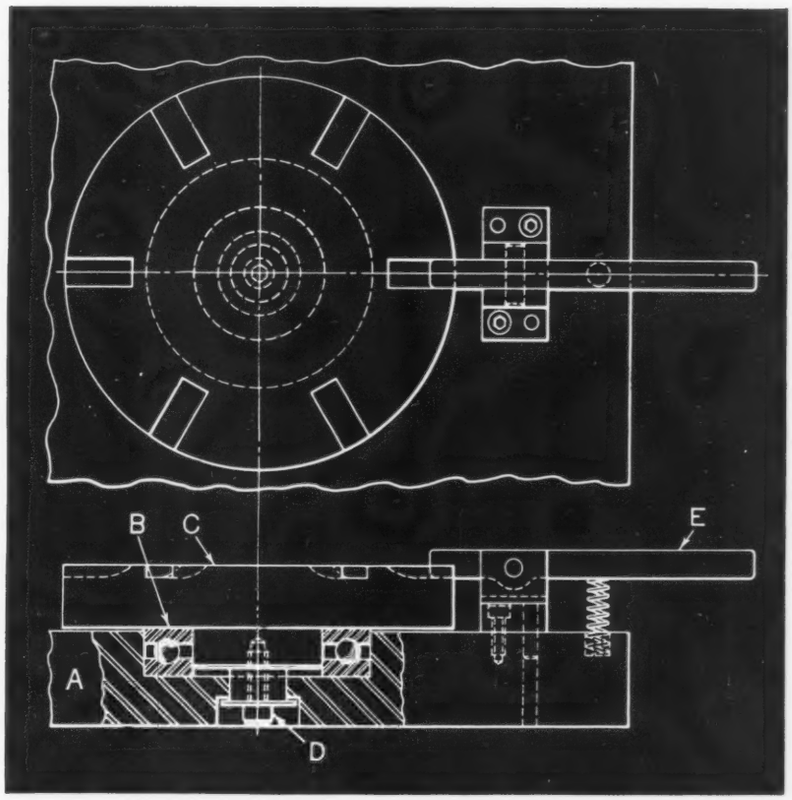
All that remains to complete the job is to provide proper clearances between the punches and dies, harden and grind where necessary, and assemble. By using ordinary tools, such as a rule, a square, dividers, and scribers, very satisfactory results can be obtained in laying out dies by this method.

Anti-Friction Support for Simple Indexing Fixture

By ROGER ISETTS, Kenosha, Wis.

The anti-friction support illustrated can be adapted for use with any type of fixture where the work must be rapidly indexed. It is rigidly constructed, compact, and will greatly reduce operator fatigue.

A hole is bored in the fixture base *A* to provide a slip fit for the standard-size ball thrust bearing *B*. The depth of the hole is made a few thousandths inch less than the thickness of the bearing, so that index-plate *C* will rotate freely.



Simple indexing fixture in which plate (C) is supported by the ball thrust bearing (B). The fixture can be rapidly rotated with ease, and the thrust of the cutting tools is taken directly by the bearing

In operation, the thrust exerted by the cutting tools will be taken directly by the bearing. Two hubs are provided on the under side of the index-plate. The larger hub is made a slip fit in the bore of the bearing, and the smaller a slip fit in base *A*. The bottom of the fixture base is counterbored to receive a socket-head cap-screw and washer, which confine plate *C* but do not prevent it from rotating. Index-stop *E* is merely representative, and can easily be varied to suit the conditions of the particular job.

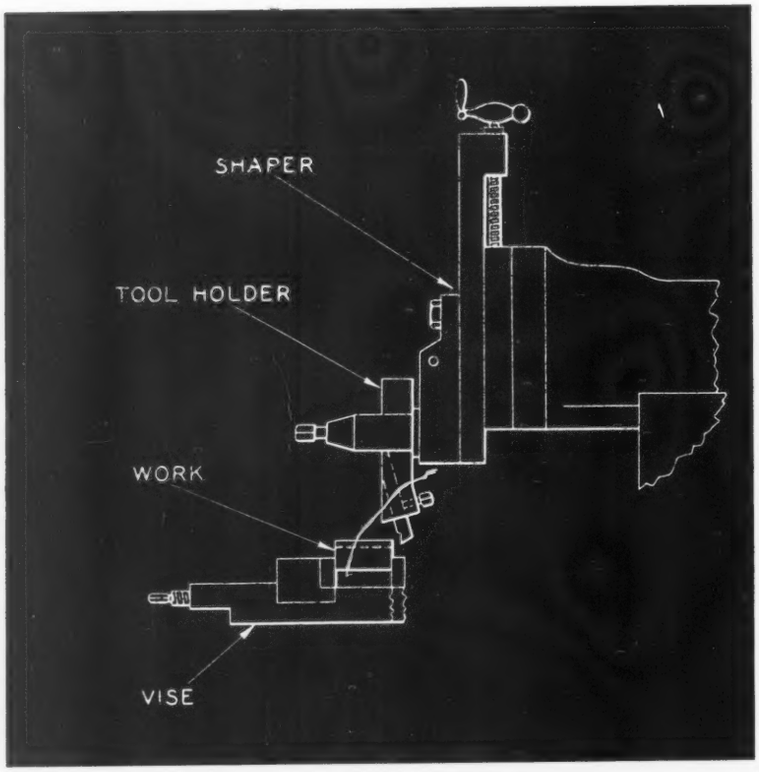
Method of Holding Shaper Tools that Reduces Breakage

By STANLEY R. WELLING, Racine, Wis.

The method of holding shaper tools shown in the accompanying illustration does much to reduce tool breakage when slotting, and also increases cutting accuracy. Often, standard tool-holders used in the conventional manner present the tool to the work in such a way that back rake becomes excessive, causing the tool to dig into the work and resulting in tool breakage.

By reversing the tool-holder, as shown, the effect of a negative rake is produced on the tool, thereby gaining the advantages of this form without special grinding. The tendency for the tool to dig in and chatter is eliminated, and, as a result, its life considerably increased.

Slotting done in this manner can be held to milling tolerances, so that work of this type can be accurately produced on shapers, thus permitting milling machines to be reserved for those particular jobs that cannot be handled on other types of machines.



Reversing the tool-holder on a shaper produces the effect of a negative rake on the tool, thereby reducing the tendency of the tool to chatter and dig into the work

* * *

Keeping a Shop File of Useful Information

By HARRY KAUFMAN

Most good kinks and new ideas for factory short-cuts, ingenious mechanisms, and practical innovations in cutting, forming, tooling, and maintenance find their way into the technical and trade magazines. These publications present the logical means for distribution of useful ideas to interested readers.

Many cost-conscious and efficient organizations interested in increasing production and cutting costs have installed a system of circulating such magazines to their foremen through the local mail distribution system. It should require no effort for a foreman to initial a kink or new idea that applies to the work in his shop at the time he reads it.

When the magazine has completed its rounds, it should be turned over to a messenger boy, who, in his spare time, could cut out all initialed items, mount them uniformly, sort them according to the foremen who have marked the items, and deliver them in small lots after they have accumulated.

The foreman, previously supplied with a box in which the mounted clippings fit freely, can then roughly index the item and file it accordingly. Having the foreman index his own file is important, as usually no two people see the same item in the same light, and the general heading of a magazine article is often best changed to the specific application it would have in a particular shop.

Such a file of indexed useful articles will prove valuable to any shop by making cost-cutting and time-saving ideas readily available to the shop foremen.

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Verbal Guarantee of Machinery Salesmen

N. M.—One of our salesmen sold a machine under a written contract which stated our guarantee. Now the purchaser is suing us, claiming that we did not conform to the verbal guarantee given by our salesman. What can we do to win the suit?

Answered by Leo T. Parker, Attorney at Law
Cincinnati, Ohio

If the intentions of the contracting parties are readily ascertainable by reference to a written contract, or correspondence, testimony of oral promises and guarantees will not be considered by any court in deciding a law suit. In Goldstein vs. Welded Products Co. [164 Pac. (2d) 229], it was shown that a buyer and seller signed a written contract in which the seller guaranteed that a baling press would have sufficient power to compress light sheet-metal scrap into bundles having a maximum size of 14 by 18 by 24 inches. Later correspondence also made reference to the same guarantee.

The purchaser refused to pay the agreed price, contending that the seller had verbally guaranteed that the press would bail a minimum of twenty tons of metal per eight-hour day, but that the press would not do this amount of work. The higher court held the purchaser liable for full payment, saying: "The defendants (purchaser), by the offered evidence, sought to prove that, prior to the execution of the written contract, oral representations and statements were made whereby the plaintiff (seller) agreed to construct a press materially different from the press mentioned and described in the written contract. The evidence offered tended to vary, contradict, and impeach the terms of the written contract. It was, therefore, inadmissible."

Also, in Silver vs. Bow [157 Pac. (2d) 785], the testimony proved that a seller sold a used machine under a written contract of sale which contained a clause that it was accepted by the purchaser without warranty. In later litigation, the buyer attempted to testify that the seller's salesman verbally guaranteed the machine. However, the court held invalid verbal promises allegedly made by the salesman.

In another case—Thompson vs. E. W. Jones, Inc. [118 Pac. (2d) 196]—the court said: "The execution of a contract in writing, whether or not the law requires it to be written, supersedes all oral negotiations or stipulations concerning its matter in the absence of accident, fraud, or mistake. Any representation made prior to or contemporaneous with the execution of the written contract is inadmissible to contradict, change, or add to the terms plainly incorporated into and made a part of the written contract."

Welding Aluminum Parts without Deoxidizing

B. O. M.—Can we spot-weld aluminum parts together without first removing the oxide coating on the aluminum? The elimination of precleaning would help greatly in reducing production costs.

Answered by Reynolds Metals Co.,
Louisville, Ky.

Yes, aluminum is being spot-welded satisfactorily without the prior removal of the oxide film. However, whether or not you can do so without trouble depends upon the welding equipment you are using, its adjustment, and the strength and consistency that you require in your welds.

Welding equipment manufacturers, in general, do not recommend attempting to do this if uniform welds of maximum strength are required. However, in such cases, you may be able to use additional welds to obtain the required strength. If so, you can certainly make an appreciable saving by elimination of the work involved in deoxidizing or precleaning.

Equipment manufacturers report that the use of a preheat current immediately before the welding cycle appears useful. Additional electrode pressure is also helpful, but electrode life may be low. It should be pointed out, however, that it will not be possible to obtain consistent, high-quality welds in aluminum without preliminary deoxidizing.

Computing Return on Invested Capital

A Study in Machine Tool Arithmetic Made by the National Machine Tool Builders' Association*

IN most manufacturing enterprises, profits are made in the face of competition by cutting costs. In the metal-working field such reduction of costs is accomplished largely by the progressive installation of new and better machine tools. All manufacturers know this; and yet many hesitate to make new equipment purchases to the full extent that their instinct and judgment suggest, for lack of convincing and specific evidence in dollar terms.

The shop superintendent may feel quite sure that a certain new machine tool will cut costs and thereby add to profits. But he may not know how to translate production hours saved into terms of yield on the capital so invested. The financial man knows yields on stocks and bonds, but this type of experience does not help him with machine tool arithmetic. Figures as to just what the new machine tool would do, dollar-wise, over the investment period representing the estimated profitable life of the machine, are therefore lacking; and the broad premise that the new machine would "probably save money" is not enough to lead to a decision to purchase it.

The fact is that thousands of companies are failing to realize their proper measure of potential profit merely because they have not known how to work out, in black and white, the dollars and cents details of the effect of new machine tools on various of their operations. The "machine tool arithmetic" method described here is, of course, only one of several in use. It is suggested as the method most practicable for the average manufacturer.

Step No. 1 — The first step in machine tool arithmetic is to determine what the new machine will save in direct labor costs. This is the place to start because it is the most important consideration, and can be determined accurately.

Here is an actual example of the method employed: A company considered the advisability of replacing one of its machine tools by a modern, improved, and faster model. The cost of the proposed new machine was $7055. On the job under consideration, the old machine turned out 120 pieces per hour, whereas the new machine could turn out 200 pieces per hour.

Assuming a direct labor rate of $1.50 per hour (excluding fringe benefits) and assuming an eight-hour day, comparative labor cost per piece was calculated as follows:

Old Machine

120 × 8 = 960 pieces per eight-hour day
960 ÷ $12.00 (labor cost) = $0.0125 per piece

New Machine

200 × 8 = 1600 pieces per eight-hour day
1600 ÷ $12.00 = $0.0075 per piece

The cost of 1600 pieces then is:

(Old Machine) 1600 × 0.0125 =	$20.00
(New Machine) 1600 × 0.0075 =	12.00
Saving in each eight-hour day	$ 8.00

In a month (21.7 days), the savings by the use of the new machine would be $173.60; and in a year, $2083.20.

In short, the new machine, costing $7055, would save $2083.20 per year in direct labor costs.

Step No. 2 — Labor cost consists not only of the gross wage shown on the operator's pay envelope, but also includes those factors known as "fringe benefits," which form part of overhead and bear a relation to direct labor hours; for example, the employer's expenditures for unemployment and old age benefits (Social Security); paid vacations and holidays; group insurance, disability, etc.; sick pay, hospitalization, and medical service; retirement plans; cafeteria losses; and mutual aid. The amount of fringe benefit cost saved by the new machine can be calculated with reasonable accuracy.

Additional Benefits Derived from Installation of New Equipment

So far we have considered savings that can be determined by definite calculations. Over and above these considerations, however, are some

*Reprint of a booklet published by the National Machine Tool Builders' Association, Cleveland 6, Ohio.

other important possibilities, which cannot be appraised so easily. All of them may not result from every replacement; some of them almost invariably do. In some cases, just one of these collateral benefits may outweigh in importance any other consideration. Thus a saving in space, because three new machines will produce more than five of the present machines, may enable management to increase capacity without expensive building alterations or additions.

Among these additional benefits may be greater safety—lower rates for workmen's compensation; lower maintenance costs; lower costs for indirect labor; reduction of scrap; reduction of "down time"; elimination of a production bottleneck; saving in floor space; better operator morale; elimination of machines by combining operations; reduced in-process inventory from faster flow of materials; faster assembly of the finished product; and longer life and better operation of the finished product.

The nature and extent of these added economies vary, of course, in each plant and with the circumstances; but at least an estimate of these savings can be made.

In the example given, let us assume that fringe-benefit savings plus estimated additional benefits would total $150 a year. Then the total annual savings are:

Direct labor savings (as calculated)	$2083.20
Saving in fringe labor costs (as calculated) and additional benefits (as estimated)	150.00
Total annual savings	$2233.20

Step No. 3—The third step has to do with depreciation allowances and federal income taxes. Based on experience over many years, it may be said that designs in the machine tool industry have a relatively short life. The capital we are about to invest in the new machine should be entirely recovered from earnings before a new machine tool or a new method renders it obsolete. It should usually be written off in ten years. The United States Treasury, however, may not allow so rapid a recovery of the capital invested. The periods on which the Treasury insists vary from fifteen to twenty-five years, depending on the type of machine; the average is about twenty years.

However, you can recover the total cost of the machine in ten years realistically, in spite of the limitations set up by the United States Treasury. This can be accomplished in the following manner: One half can be recovered on a tax-free basis through allowable depreciation charges, and the other half from profits after taxes. This procedure is illustrated by the following computation, based on a cost of $7055 for the new machine, as given in the example:

Estimated profitable life of the machine is ten years; therefore, the capital invested should be recovered at the annual rate of $7055 ÷ 10 = $705.50.

Tax regulations permit the tax-free recovery each year of $7055 ÷ 20 = $352.75. Then the additional amount to be recovered out of profit each year is $352.75.

To recover $352.75 out of profit when the tax rate is 38 per cent, this machine must earn every year $568.95.

Therefore, the company must recover annually, over a ten-year period, $352.75 through depreciation and $568.95 in profit (before taxes), or a total of $921.70.

Only one further simple calculation determines the rate of yield on the $7055 capital invested:

Annual savings	$2233.20
Required annually for recovery of capital in ten years.....	921.70
Annual net return on investment	$1311.50

In short, over a ten-year period, the entire capital investment will be recovered, and meanwhile will earn $1311.50 a year—a return of 18.5 per cent.

Application of Method to Tool-Room Machines

It may be suggested that this method of analysis does not lend itself readily to the appraisal of tool-room machines, which are not steadily engaged in production. Actually, the production figures on several typical jobs, on the present machine and on the proposed machine, will give a close indication of the returns that can be earned, even though exactly the same jobs may not be handled on that machine in the future. Time savings are all the more important in this case because this is inherently an expensive department.

However, the prevailing consideration is likely to be the "additional" benefits, for poor work in the tool-room means scrap or salvage costs in the shop, and delay in the tool-room is just as serious as delay anywhere in the production line. The tool-room lies at the heart of production.

Rebuilding versus Replacement of Machine Tools

A similar analysis can be made to determine whether a thorough overhaul of the present machine tool is warranted. If the machine is overhauled, there is a reduction of subsequent main-

tenance expense and a gain in the accuracy of work produced, but the far greater savings in direct labor resulting from increased output and several "additional benefits" are not gained.

Some companies having obsolete machines which are not fully depreciated add to the price of the new machine the amount which they have not yet recovered on the present one. This is not

WORK SHEET

The Cost of the New Machine is $.....

	OLD MACHINE	NEW MACHINE
Direct labor cost per hour.....	$_____	$_____
Fringe benefits per hour	$_____	$_____
Total hourly labor cost per hour.....	$_____	$_____
Divided by the number of parts produced per hour-units....	(_____)	(_____)
Gives us total labor cost per piece	$_____	$_____
•		
The new machine produces ..... pieces per day		
At $..... per piece on old machines they would cost.		$_____
At $..... per piece on new machines they would cost		$_____
Labor savings per day.....		$_____
Annual savings, labor (40-hour week, 50 weeks per year).....		$_____
Estimated additional savings per year		$_____
Total Annual Savings.....		$_____
•		
Desirable annual rate of recovery of capital invested in the new machine assuming it has a 10-year* profitable life (1/10 of cost).....		$_____
Amount recovered annually tax-free by 20-year* depreciation schedule (½ of above)		$_____
Additional amount to be recovered annually out of profit.....		$_____
Earnings required annually before taxes (at 38%) to recover above amount (above figure divided by .62).....		$_____
Annual capital recovery required over the 10-year period; $..... from depreciation plus $..... from profit before taxes		$_____
•		
Total annual savings.....		$_____
Required annually for recovery of capital.....		$_____
Annual net return on investment.....		$_____
Rate of annual return on capital invested; annual net return of $..... divided by $....., the cost of the new machine.....		_____ %

* *These periods vary, of course, depending on the nature of the machine and the product.*

believed to be sound practice. At the time the present machines were installed, a period of "useful life" was estimated—and, as it turns out, was set too long. This is usually due to Treasury policy. It is now unwise to defer the profit that can be earned by the new machine because of a theoretical depreciation rate set up many years ago to conform to Internal Revenue practice. The "profit and loss" account should be charged with the difference between the unrecovered capital and the amount for which the used machine is sold. Adding unrecovered capital to the new machine price will tend to reduce the percentage of earnings of the new machine, but too slightly to affect the outcome.

In some cases, the old machine has been fully written off, and yet can be sold on the used machinery market. Some companies subtract this return (after deducting the capital gains tax) from the price of the new machine. This is not good accounting practice—the new machine should show an earning of satisfactory size on its own cost.

Subtracting the sum for which the old machine is sold from the price of the new one increases the percentage that will be earned by the new machine, but, again, the effect is usually small.

Machine Tool Salesman Can Estimate Savings Possible with New Machines

The key to machine tool arithmetic is the machine tool salesman. Shown the particular operation and given all the surrounding factors, he can furnish an estimate as to the savings which a new machine would effect.

The shop superintendent cannot gage accurately the performance of a machine with which he is not familiar and with which he is not working. The machine tool salesman, however, knows the new machine and its possibilities. It is part of his business to secure for the customer an estimate of production from the new machine. With estimates in hand as to possible savings effected on various operations by new machine tools, the potential yield on the capital to be invested can be computed.

The manufacturer who thinks of productive equipment in terms of yield on capital will make a periodic review of the machine tools in his plant, just as an investor reviews a portfolio of stocks and bonds to see which ones can be replaced in order to achieve a higher yield. Such a study will point unerringly to the obsolete machines which limit the profit potential in any plant and which, viewed in the light of replacement arithmetic, the manufacturer can no longer afford to keep. Every manufacturer should know just which machine should be first on the list for replacement. The calculations outlined in the accompanying "Work Sheet" will enable him to make that determination.

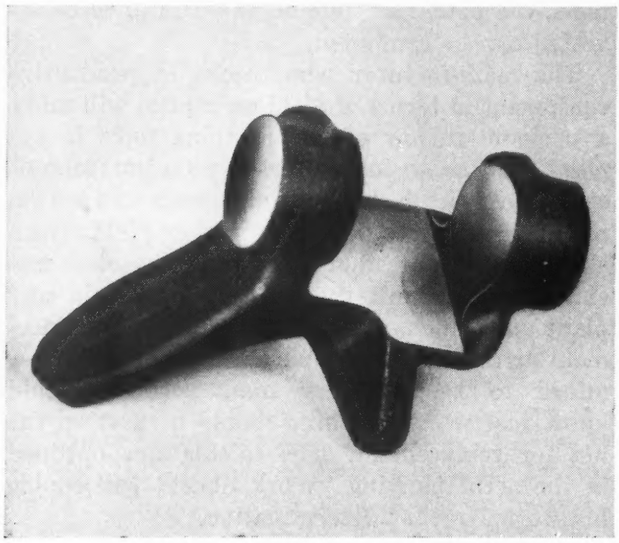
* * *

In spite of the fact that the United States produced 85 per cent of all the passenger cars assembled in the world in 1948 and sold all except 6 per cent of them in the home market, American imports of foreign-made cars surpassed those of all the countries of the world, except Australia and the Union of South Africa.

Ram truck that lifts and carries 60,000 pounds of steel, constructed by the Automatic Transportation Co., Chicago, Ill. The truck is 182 inches long, plus a 78-inch ram on which the steel coils are carried. The ram is located 14 inches above the floor, from which point it can lift its load another 86 inches

Hydraulic Clamping Facilitates Broaching of Odd-Shaped Parts

Broaching operations on the odd-shaped combined automotive steering idler and third arm bracket shown in Figs. 1 and 2 are made easy by the use of hydraulically clamped fixtures. Another method of saving time in performing the broaching operations is mounting the fixtures on receding platens. This arrangement permits loading of the work during the return stroke of the corresponding broaching ram. Two broaching operations are performed on this part with machines and tools built by the Colonial Broach Co., Detroit, Mich. The machines are of 15 tons capacity, have a 66-inch stroke, and are of the dual-ram type.



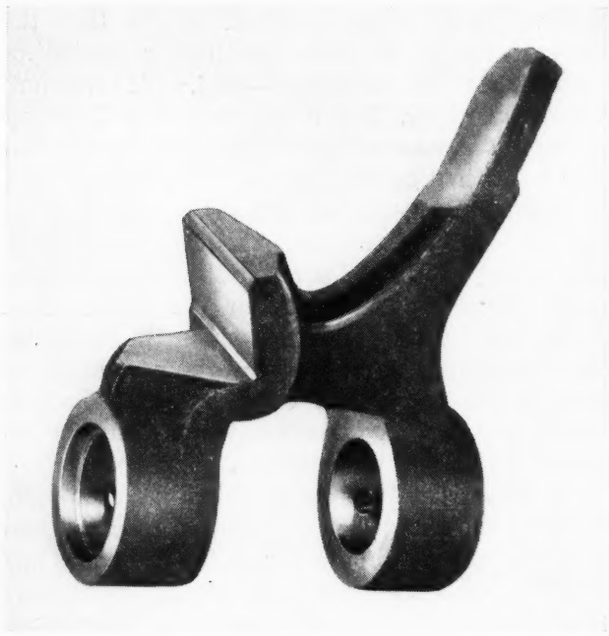


Fig. 1. (Left) Automotive steering idler and third arm bracket which is broached as indicated on the dual-ram machine illustrated in Fig. 3

Fig. 2. (Above) Another view of the part as it appears after being broached in a second operation on a similarly equipped machine

In the first operation, the four faces of the yoke are straddle-broached and the flat between the two bosses is finished, as shown in Fig. 1, all in one stroke of the machine. Both stations on the dual-ram machine do the same work, so that two parts are broached at every complete cycle of the machine.

In the second operation, which is performed on another machine, other surfaces of the part are broached simultaneously. The appearance of the bracket at the end of this operation can be seen in the illustration Fig. 2.

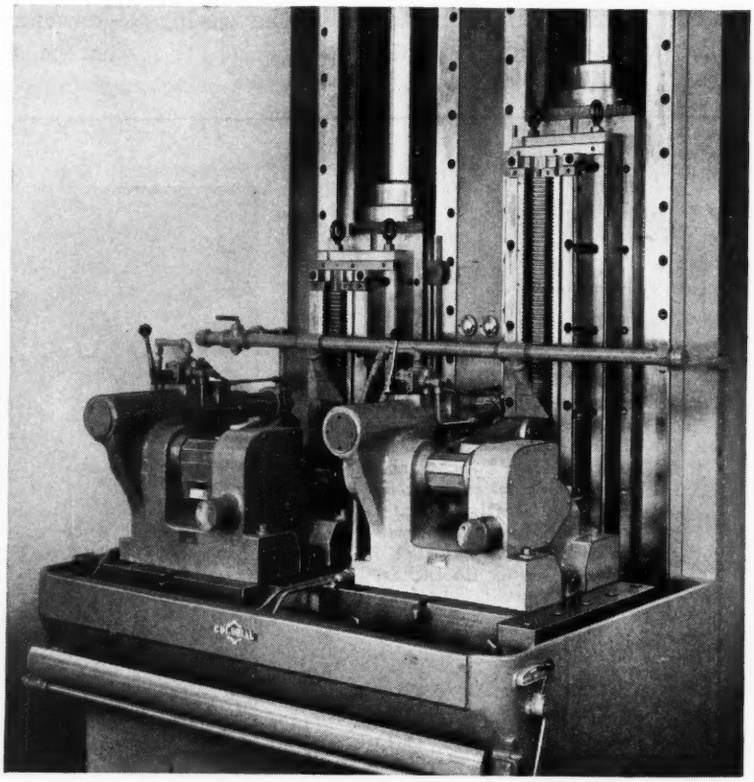


Fig. 3. Colonial dual-ram broaching machine equipped with hydraulically clamped fixtures and receding platens that facilitate reloading

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester, Hankins & Silver
Sales Management Engineers
New York and Philadelphia

A Fairy Tale — Plus

OLD Jim Blake owned the business he founded fifty years ago—building machines for making the holes in cheese. His company claimed to be the leader in its field.

Old Jim Blake had seven sons. Bill managed the business, and Harry kept the books and the money. George designed bigger and better cheese-holer machines, while Phil built them. Sam bought every single thing needed. Ralph—filled with vigor—sold the cheese-holers, and Dan, the youngest, diligently serviced them.

Old Jim Blake mostly sat at home now. Recently he started worrying because Sam had bought a bottle of red ink, and Harry used it on the books. Yet old Jim still had a sizable balance at the First National.

One day a young, golden-haired machine tool salesman came along. As many of us do, he called upon the buyer. "No. We're not buying any tools," Sam said gloomily. "Looks like we might have too many now. Phil uses them. He knows about that."

The salesman found Phil in the shop arguing with Dan, the service man, over a couple of cheese-holer machines just returned from a customer in Wisconsin. They hadn't worked right. Both men were worried. "Can't repair them in the field," Dan was saying—"loose bearing, poor limits, I reckon. When brother Ralph finds out we lost a good customer, he'll be mad."

"That's all you can expect with the old reamer we have," muttered Phil.

Here's where our golden-haired salesman got to work. He found reaming was only one thing wrong. "It's no use," Phil said. "I've told my brothers, time and again, we've got to spend money to fix this place up. But Harry is tight with the money—tight as a lobster claw."

"Aha" exclaimed the salesman, "I must see the money man." On his way, he passed an office door with a sign on it, "Ralph Blake—Sales Manager." Sticking his head in the office, "Good morning, Mr. Blake" he said politely. "How are your cheese-holers going?"

"Business is none too good," Ralph solemnly answered, "even if folks are eating more Swiss cheese. Got an idea, too, that our machines are being rejected, but Dan hasn't told me yet. Maybe we can't build them right. And then I've got a sneaking idea that our cheese-holer machines are getting out of date—the design I mean. George will have to pull off some new tricks on his drafting board. But it all takes money."

George was bent over a drafting board when the young sales engineer entered. He pointed to a line on the drawing. "Durned if I know whether Phil's fixed to grind that surface right, even if we ever did build this new super-duper automatic machine. And I guess Harry would put the crimp in spending the money for the proper grinder."

Finally our salesman reached Harry, the money man. He saw the bottle of red ink on the desk. "You've always got to give to get, Mr. Blake, or invest to win," exclaimed the salesman innocently. "I've heard that said," replied Harry, his eye fixed absent-mindedly on the bottle of red ink. "Got to watch the pennies."

Time passed. Sam bought a second bottle of red ink because Harry needed it for the books. He even bought a red typewriter ribbon for his reports to brother Bill, the manager. But our salesman continued his visits.

Then one day the golden-haired salesman appeared with a complete proposition for a group of new tools tailored to take care of Phil's present production and George's design of a new super-duper automatic cheese-holer. It looked good to Harry, George, Sam, Phil, Ralph, and Dan. "But you'll have to get Bill back of it," they said,

"Pop holds him responsible. He runs the outfit."

When our young salesman entered Bill's office he was poring over figures—some black, some red. Listening to the sales engineer's proposal, "I think you've got something there, young man. Are the other boys all for it? Well, then, we'd better see Pop—he's got the funds."

Old Jim Blake was sitting in the parlor at home. A shaft of evening sunlight cast a glow upon his gray hairs and the financial sheet before him when Bill Blake and the salesman drove up and entered. "Let's get it straight," the old man said, after thumbing the proposal. "How much money—how much profit?" "There's the answer," said Bill, pointing to the salesman's proposal. "Those figures are conservative. The other six boys and I have gone over them."

Finally old Jim leaned back, his tired eyes turned toward the distance. He spoke reminiscently... "Put my life in the business, and set up my seven boys to run it. I spent money—sure I did—to get a return." Suddenly he fixed his eyes intently on Bill. "You're on the right track; we'd better go ahead. Go over to the First National, tell them about it. Arrange for the funds and... Good luck to you, golden-haired machine tool salesman!"... and all nine men—father, sons, and salesman—lived happily ever after.

Every fairy tale has a moral. This one has several. But you've guessed the big point. Jim Blake and all seven sons had a hand in buying. Our golden-haired salesman sold each and every one of them.

* * *

Tool for Forming Small Metal Clips in One Press Operation

By J. C. MURGATROYD

Small tubular-shaped parts like the clips shown in Fig. 1 are usually formed in two separate press operations. Because the production requirements for one particular clip were high and the clip was small (1/4 inch outside diameter by 0.015 inch thick), it was desirable to complete the forming in one operation. The tool that was developed for this purpose is illustrated in Fig. 2.

Forming is accomplished by two clapper blocks *A*, which are pivoted and supported in a block and held open by a spring-loaded plunger *B*. The blank for the clip to be formed is laid on top of the jaws, which are provided with projections for locating the blank.

When the punch, mounted on the ram of the press, descends, arbor *C* first draws the blank between the open jaws into a U-shape. When the arbor reaches the bottom of the form in the jaws, it causes them to close and form the clip completely around the arbor. Alignment between the punch and die is maintained by a guide slot machined in the jaw block. The punch carries a sliding block *D* which, besides acting as a support for the front end of the arbor, serves as a hand-operated, spring-returned ejector for removing completed clips from the arbor.

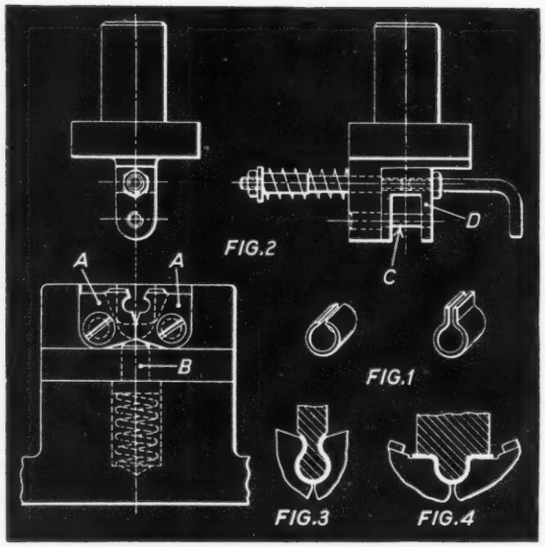


Fig. 1. Small clip formed in one press stroke. Fig. 2. Tool employed to form clips completely in one operation. Figs. 3 and 4. Other open-sided parts formed with the die shown in Fig. 2 by modifying punch and jaw shapes

Other open-side forms, such as those shown in Figs. 3 and 4, can be produced in this type of die by modifying the shapes of the jaws and punches. For these parts, however, the punch must be shaped to correspond with the inside form of the work.

* * *

Handbook on Principles of Exporting

The Office of Small Business of the Economic Cooperation Administration has issued a handbook on the principles of exporting, designed especially for the small businessman considering export trade under the Marshall Plan. The booklet, which is entitled "Guide for the Prospective Exporter," contains fifty-one pages analyzing the ten steps essential in planning an export business. It points out methods of gathering adequate information so that correct policy decisions and plans may be made for engaging in foreign trade. Copies of the booklet can be obtained by writing to the Economic Cooperation Administration, 800 Connecticut Ave., Washington 25, D. C.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Monarch Special Lathe for Determining Machinability of Free-Cutting Steels

The Monarch Machine Tool Co., Sidney, Ohio, has brought out a lathe of special design to provide a dependable means of predetermining the machinability or turning qualities of free-cutting steels. The lathe is designed to simplify and speed up this work by shortening the testing period; providing sensitivity of a high degree; accurately producing test results whenever required; and giving machinability ratings that correspond closely to values established by conventional laboratory tool-life tests and large-scale commercial machining operations.

Constant-pressure lathe tests of small samples from single steel bars selected from large stocks make it possible to determine the probable machinability of the entire lot. The specially equipped lathe provides fixed tool pressures with a constant component in the horizontal feeding direction, developed during a cooperative research project recently conducted at the Battelle Memorial Institute under the sponsorship of the Carnegie-Illinois Steel Corporation. The steels considered in this particular study were types ordinarily handled in automatic screw machine work. The test method employed is based primarily upon the fact that steels of different machining qualities will be cut at different rates when a horizontal pressure of fixed value is applied to the tool through the feed mechanism of the lathe.

The special Monarch lathe used for the machinability test differs from a standard machine in three respects: First, the tool carriage (Fig. 2) is disconnected from the fixed-feed mechanism and mounted on anti-friction bearings, so that it can be moved easily along the bed; second, the lathe is designed to apply a predetermined horizontal pressure on the tool; and third, a mechanical counter, shown in Fig. 3, is used to record the number of spindle revolutions and measure the tool travel.

The lathe has a 5-H.P. driving motor; sixteen spindle speeds ranging from 24 to 1000 R.P.M.; a 16 1/2-inch swing; and a distance between centers of 30 inches. The carriage is equipped with metal shields to prevent chips from falling into the ways of the unit and collecting under the ball bearings on which the carriage is mounted.

Behind the handwheel is a drum around which piano wire, 0.031 inch in diameter, is wound and then carried across three different pulleys, arranged as shown in Fig. 1, for the suspension of weights from the third pulley. This weighted wire, passing across the section ordinarily occupied by the gear-box of a conventional lathe, serves to pull the carriage toward the work. The rate of carriage travel depends not only upon the weight used, but also upon the resistance to cutting offered by the steel test piece and the chip friction encountered as the work moves over the tool. By adding or subtracting weights from the wire, the horizontal feed

Fig. 1. Machinability-testing lathe built by Monarch Machine Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 226.

of the carriage can be increased or decreased. Travel of the weights from the floor to the top pulley gives a carriage travel of 7 inches.

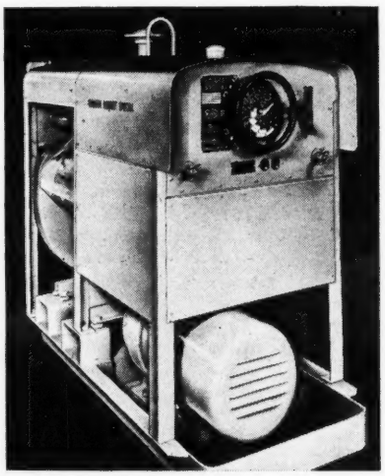
A solid-block tool-holder (Fig. 2), rigidly fastened to the compound rest, is especially designed to hold the tool so that its edge forms a right angle with the direction of tool travel and the axis of the steel bar being tested. As shown, clamping bolts hold the tool, pressing it against a wedge which rests against the tapered bottom of the groove, permitting the tool to be adjusted quickly so that the cutting edge is at the same height as the center line of the test bar. A 3/4-inch square high-speed steel tool bit with 12-degree rake and side clearance angles is used. Mounted directly in back of the tool-holder is a dial gage that measures the distance from the top of the tool-post to the cutting edge of the tool, this tool position being constant for all tests.

The bar stock to be tested is mounted in the collet chuck, which takes stock up to 1 1/2 inches in diameter. In general practice, however, a piece 7/8 inch in diameter is used for the test. The tool is set for a cut 1/8 inch deep, and a weight of 6 pounds is applied to the piano wire. With the pulleys and levers providing a mechanical ratio of 13.2 to 1, a tool pressure of approximately 80 pounds is obtained. The lathe spindle is run at a speed of 377 R.P.M. As the tool advances, four pins in the first pulley, mounted at the bottom of the column at the left of the machine, actuate a switch, closing the electrical circuit at each 0.2-inch increment of tool travel. When this occurs, a signal bell rings. A mechanical counter, installed on the left of the headstock and driven by roller chain and sprockets connected to the lathe spindle, records the number of spindle revolutions, indicating every second revolution.

The combination of these two measuring devices provides data that shows accurately the amount of metal removed. The standard test norm is 377 R.P.M. at 81 pounds tool pressure and a feed of 0.003 inch per revolution. As greater or less weight is applied to increase or decrease the pressure, the corresponding change in the machinability index is obtained. It is the usual practice to make about ten test runs on each batch of steel. 61

Machine-Driven Arc-Welder

The 200-ampere Hornet "Special" arc-welder recently brought out by the Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., combines a compact 36A generator with a four-cylinder 31-H.P. air-cooled Wisconsin engine. The generator has a welding range of from 40 amperes at 20 volts to 250 amperes at 40 volts. The control wheel, mounted on the panel, shows accurate current markings, which are readily obtained by setting the pointer at the center of the wheel. The wheel has five positions with ample overlap to insure fine settings over the full output range.



Machine-driven arc-welder brought out by the Air Reduction Sales Co.

The excitation of the main field of the generator is supplied by an auxiliary brush to insure instant recovery voltage over short circuits. The air-cooled Wisconsin engine has magneto ignition with impulse starting. The complete welder is 58 1/2 inches long, 25 5/8 inches wide, and 47 inches high. It weighs 825 pounds.....62

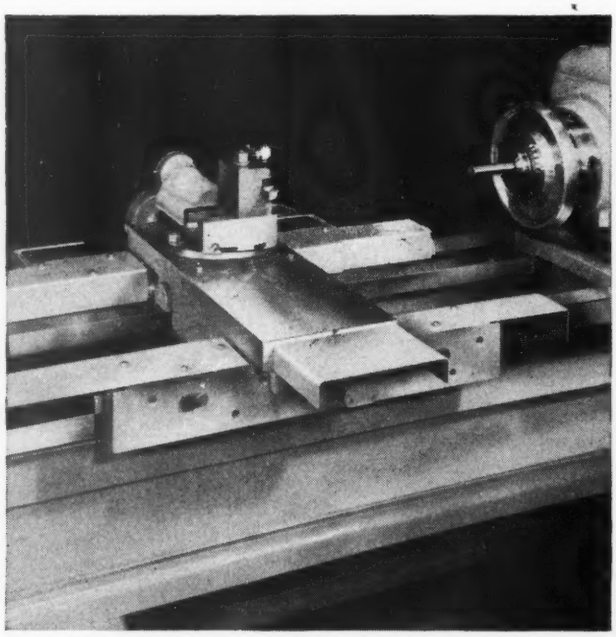


Fig. 2. Close-up view of special tool-holder used in machinability-testing lathe shown in Fig. 1

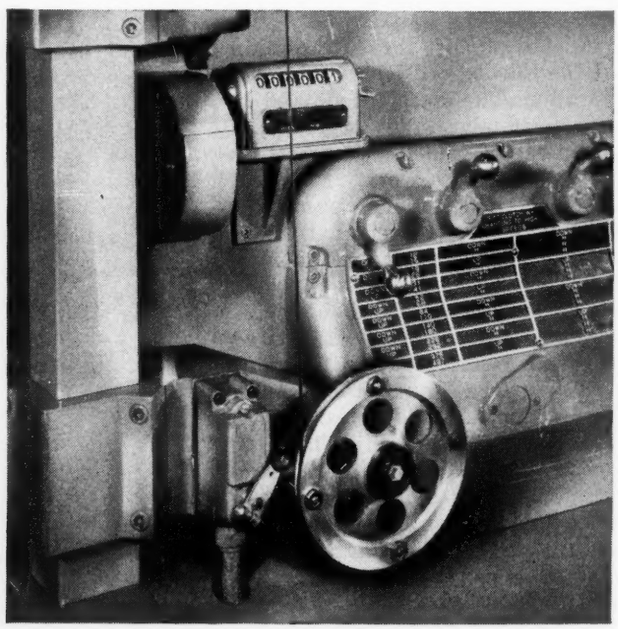


Fig. 3. View of ball-bearing wire-cable pulley mounted on the column of machine shown in Fig. 1

To obtain additional information on equipment described on this page, see lower part of page 226.

Precision hand lapping machine built by the Taft-Peirce Mfg. Co.

Taft-Peirce High-Precision Hand Lapping Machine

A new 24-inch hand lapping machine, designed to impart the maximum degree of precision and fine finish to flat and cylindrical surfaces of small and medium-sized parts, has been announced by the Taft-Peirce Mfg. Co., Woonsocket, R. I. The speed and capacity of this machine are suited for rapid processing and small-lot manufacture, as well as for tool-room requirements. The machine is particularly well adapted for the finishing of plug gages, mold details, fuel pump housings, valve fittings, or any work requiring precision finishing or true contact surfaces.

The lapping plates of this machine are 24 inches in diameter and are furnished either plain for cylindrical work or grooved for flat work. They are made of close-grained cast iron, especially suited for fine lapping operations, are carefully treated to prevent distortion, and are precision-ground. The machine is only 37 1/2 inches high and weighs approximately 600 pounds. 63

"Husky" Power Press for Light-Gage Metal Work

The Fallsington Mfg. Co., Fallsington, Pa., has announced a new type "Husky" power press for light-gage sheet-metal work. Although designed specifically for shops manufacturing heating and ventilating equipment, this press is adapted for use wherever light sheet-metal parts must be rapidly punched, formed, blanked, or profiled. It can also be used for folding pieces up to 14 inches long. It is available in 24-inch, 36-inch, and extra heavy 36-inch models, all having a large bed area with through feed along their entire length.

The beds are 8 by 24 or 36 inches, and each machine has a 1 1/4-inch stroke with 1/2-inch shut height adjustment. The dies for blanking, forming, notching, gang punching, and trimming are made to customers' specifications. Leader pins in the die sets insure proper setting, and the die sets can be installed by any operator in four minutes. 64

Brinell Testing Balls Made of Heat-Resistant "Kentanium"

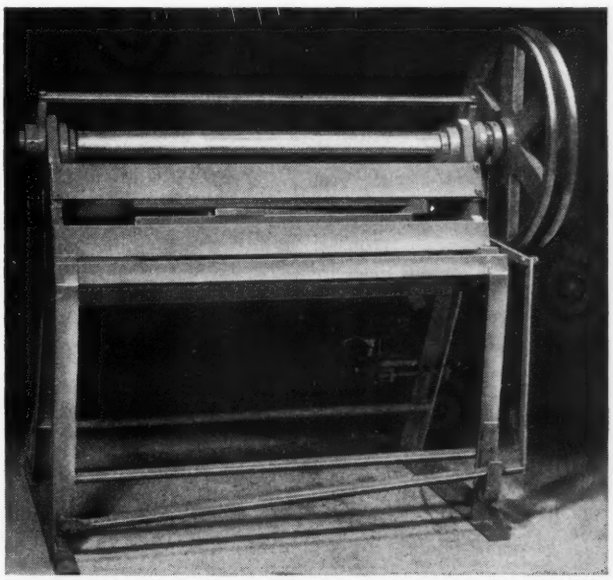
More reliable hot Brinell hardness testing of materials is said to be possible with new test balls made of "Kentanium," a heat-resistant material — basically a titanium carbide—developed and manufactured by Kennametal, Inc., Latrobe, Pa. This material combines unusual strength with high resistance to oxidation, thermal shock, abrasion, and corrosion. These properties make it suitable for a wide variety of uses where elevated temperatures are encountered.

"Kentanium" balls, precision ground to true sphericity and close tolerance, are available in the standard 10-millimeter size. 65

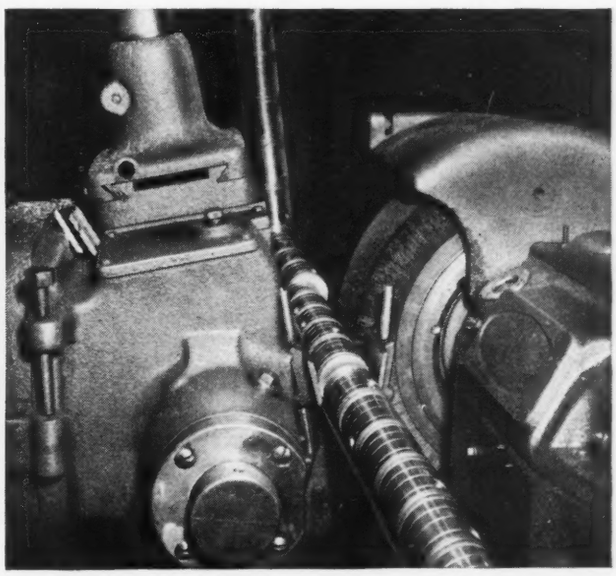
Osborn Brushes for Centerless Grinding Machines

Rotary brushes have been developed by the Osborn Mfg. Co., Cleveland, Ohio, for application on centerless grinding machines. Wire, Tampico, or synthetic rotary brushes are produced in a wide range of sizes.

The Osborn 20-inch diameter master spiral brush shown on the

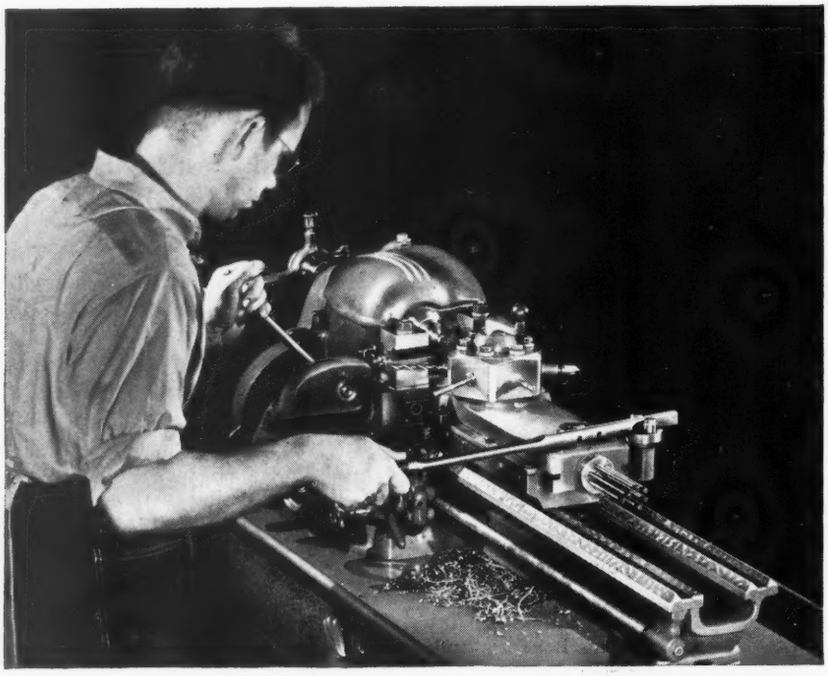


"Husky" power press brought out by the Fallsington Mfg. Co. for performing various operations on light sheet-metal parts



Osborn master rotary brush employed on a centerless grinder to obtain a high luster finish on the rounded surfaces of pistons

To obtain additional information on equipment described on this page, see lower part of page 226.



South Bend lathe equipped with new hand-lever bed turret

Cincinnati Milling Machine Co.'s centerless grinder in the illustration is being used by one manufacturer of pistons. The brush used in this case has a 6-inch face, is made from 0.005 inch diameter crimped wire, and rotates at 1200 R.P.M. The pistons are machine ground and then "centerless brushed" for finish. The work is fed by gravity from a magazine type chute. The small driving wheel, set at an angle, rotates the parts and drives them through the brush area. 66

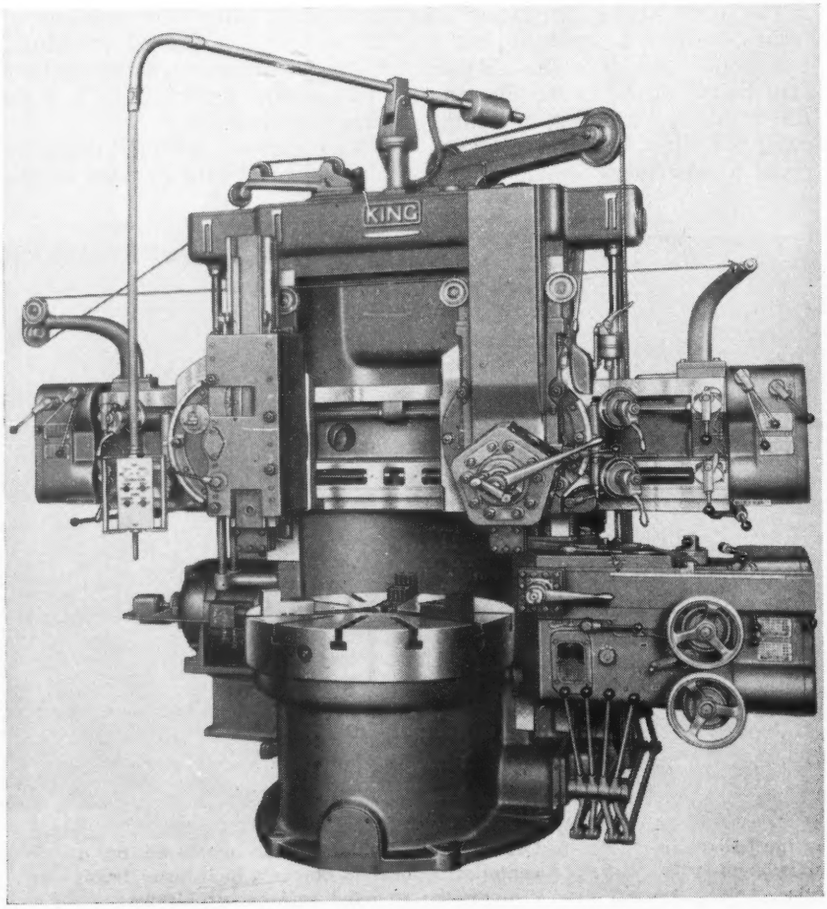
Hand-Lever Turrets for South Bend Lathes

The South Bend Lathe Works, South Bend 22, Ind., is now producing an improved hand-lever bed turret for its 9-, 10-, and 13-inch swing lathes. The new turret is so designed that, by following simple instructions, the user can accurately fit it to his lathe. Such an installation will make possible the economical production of precision parts, but will not change the basic lathe. For regular lathe work, the turret can be quickly replaced by the tailstock.

The hand-lever bed turret is mounted on the inside bed ways, and the turret base can be locked in position at any point along the bed. The effective feed of the turret-slide is 4 inches; distance from center of turret head to top of slide, 1 1/2 inches; and distance across turret head, 4 7/8 inches. The head can be bored to take six 5/8- or 3/4-inch shank standard turret tools.

When properly installed, the turret head will index to within plus or minus 0.0005 inch, measured 4 inches from the turret face. This accuracy is assured by a superfinished index pin fitted to a lapped steel bushing. The turret ram has stop-screws for each tool position, which are indexed automatically with the head. The turret head can be back-indexed or spun to skip tool positions. A crank type binder lever is provided for locking the turret head.

Available for use with the hand-lever bed turret are a square turret tool-block and a double-tool cross-slide for the 9-inch and 10-inch lathes. 67



Boring mill of new series manufactured by the American Steel Foundries, King Machine Tool Division

King Boring Mills

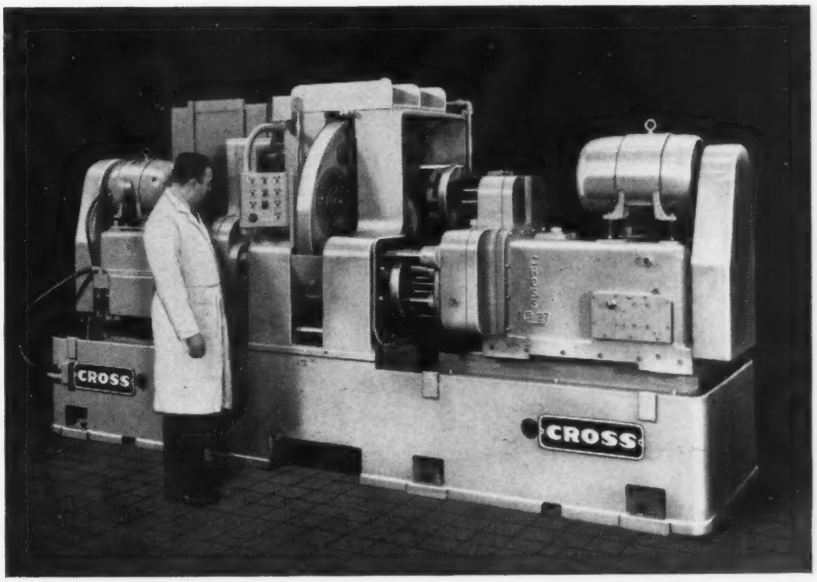
Vertical boring and turning machines manufactured by the American Steel Foundries, King Machine Tool Division, Cincinnati 29, Ohio, are now available in ten different sizes, including single-column 30-, 36-, and 42-

To obtain additional information on equipment described on this page, see lower part of page 226.

inch, and double-column 52-, 62-, 72-, 84-, 100-, 120-, and 144-inch sizes. All sizes are obtainable in a variety of head combinations, either with or without a side-head. Machines are also available either in standard design or with special variations to suit individual requirements.

Many improvements designed to insure greater accuracy, easier operation, and longer service life have been incorporated in these new machines. Heavier and more rigid construction, increased power, and a wider range of feeds and speeds serve to adapt them for the use of carbide tools.

The machine shown in the illustration is a 42-inch boring mill with a left-hand swivel ram head, right-hand swivel turret head, and side-head. 68



Machine for processing automotive flywheels, built by The Cross Company

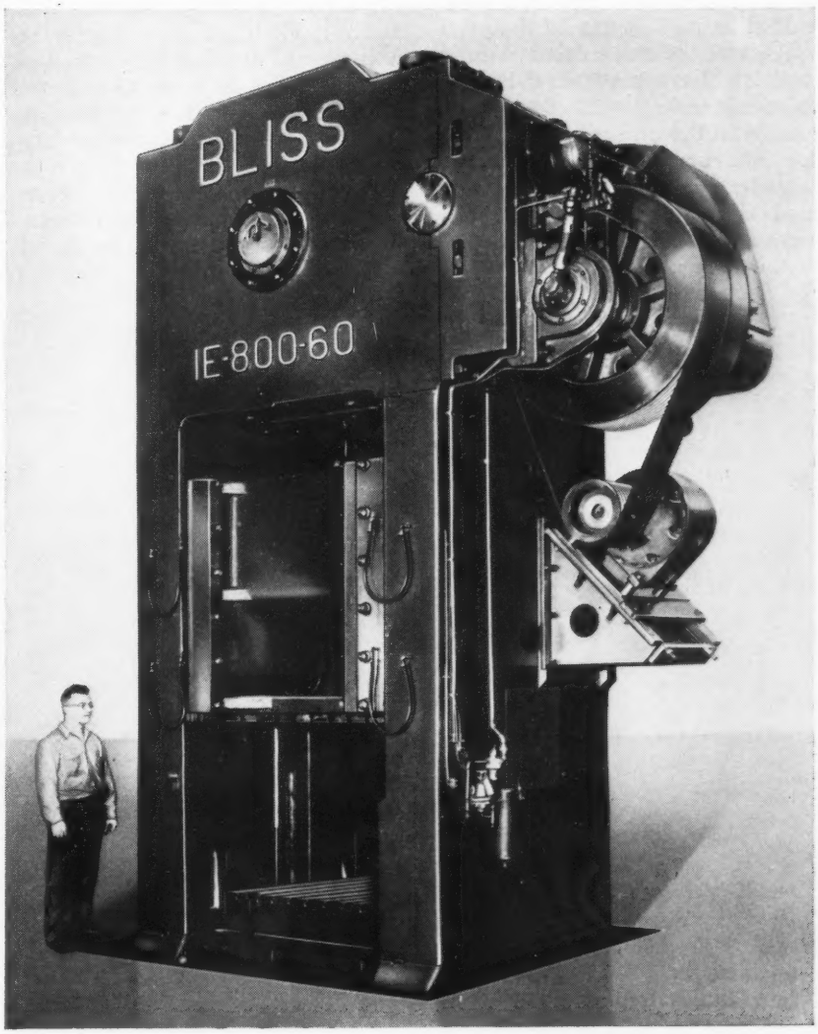
Cross Special Machine for Processing Flywheels

A special machine which can be operated by unskilled attendants has been built by The Cross Company, 3250 Bellevue, Detroit 7, Mich., for use in machining automotive flywheels. This new machine drills, chamfers, and reams flywheels at the rate of 140 pieces per hour at an operating efficiency of 100 per cent. It is of the five-station index trunnion type, employing a fluid type motor for the indexing movements.

At the first station, the operator loads and unloads the work; at the second station, sixteen holes are drilled; at the third station, sixteen holes are chamfered; at the fourth station, fifteen holes are chamfered; and at the fifth station, three holes are reamed. The operator merely positions the part in the loading station and presses the cycle button. 69

Bliss High-Capacity Enclosed Press

New enclosed one-point presses of 500 tons capacity and larger, designed with a box type crown, long fully enclosed slide, and barrel type slide adjustment, have been developed by the E. W. Bliss Co., Toledo 7, Ohio. Less head room is required for these presses than in previous designs because the main drive unit is lower and the clutch and flywheel assemblies are outside the crown. The crown, which is a long, deep box type structure, extends below the main gears, providing a rigid connection between the front and rear members. The front and rear



Bliss large capacity press designed for low head room installation

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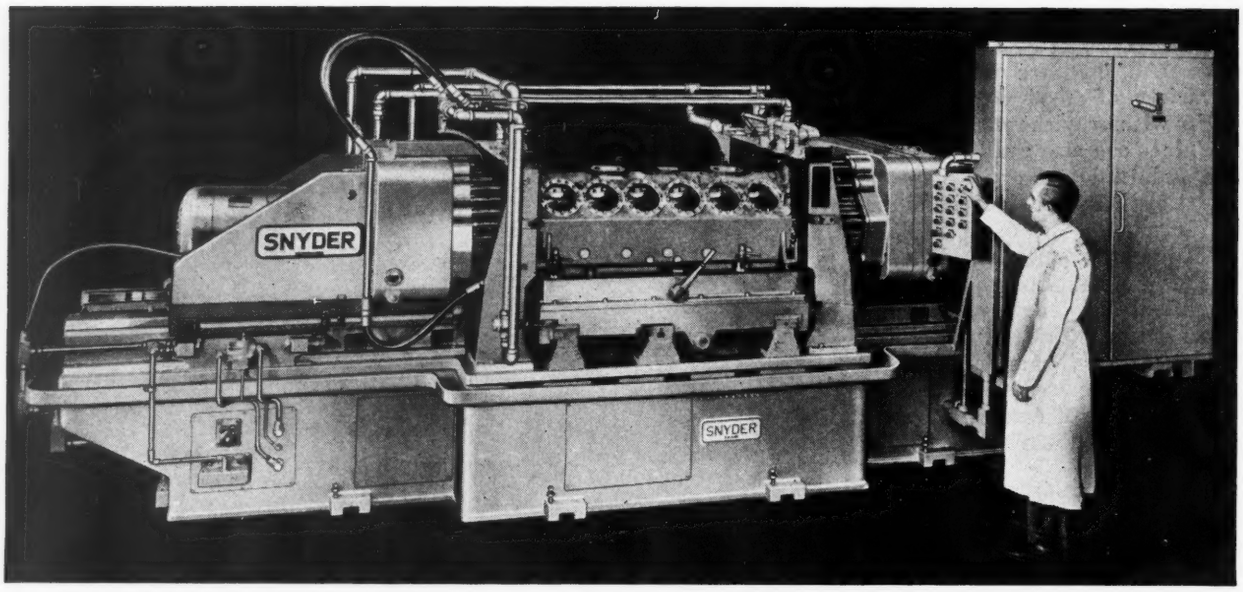


Special machine brought out by the Snyder Tool & Engineering Co. for drilling, reaming, and tapping crankcases

crown panels are of the individual box section type.

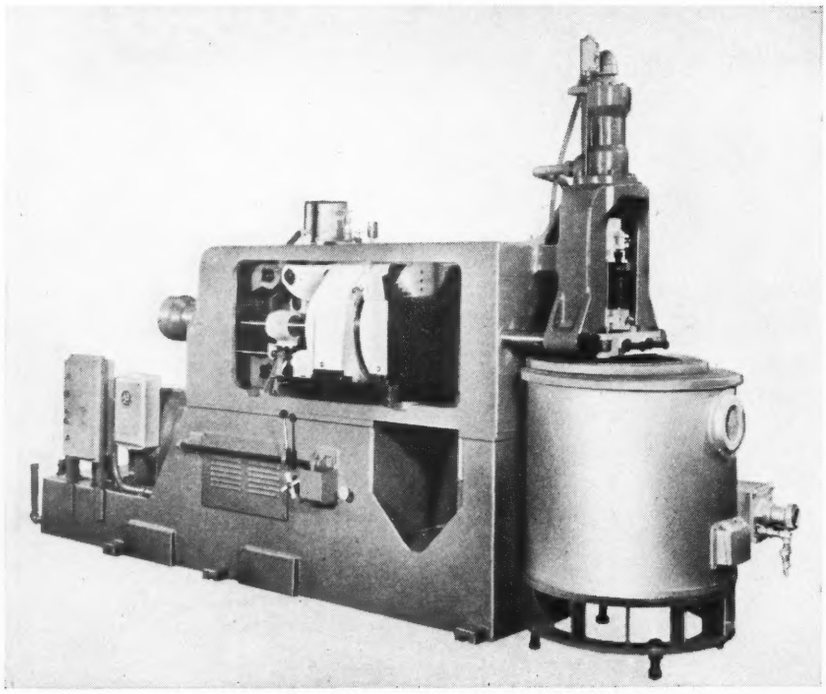
The box type slide has a power-elevating unit consisting of a worm-driven barrel type connection. The slide is completely guided by gibs at any of the positions, and the main drive is fully eccentric, having a twin drive for balanced loading. The main shaft rotates in the crown bearings and does not carry a torsional load. A cascade oil lubricating system is used throughout, except for the ways and roller bearings. 70

Snyder Two-Way Special Machine for Drilling, Reaming, and Tapping Crankcases

A two-way horizontal line index machine has been designed by the Snyder Tool & Engineering Co., Detroit, Mich., to permit greater accuracy in drilling, reaming, and tapping holes in large aluminum-alloy crankcases. The machine is equipped with two Snyder standard hydraulic slide units which carry the multiple-spindle heads for drilling and other operations. These units move on hardened and ground steel ways. Two lead-screw tapping units are mounted at the rear of the machine.

The tapping unit for the flywheel end of the part has twenty-five lead-screw spindles. One of the tapping spindles in this head is used in a separate platen for tapping the oil galley hole. High-speed steel tools are used, and the operation of drilling, reaming, and tapping a total of fifty-three holes in the flywheel end and accessory end of the work takes three minutes, plus the loading and unloading time.

Power for the heads is supplied by two 15-H.P. motors operating at 1800 R.P.M. The work cycle is automatic, following loading and manual clamping. The machine is electrically interlocked, and can be operated by unskilled help. It requires a floor space of 227 by 125 inches. 71



Zinc die-casting machine built by Lester-Phoenix, Inc.

Lester-Phoenix Zinc Die-Casting Machine

Lester-Phoenix, Inc., 2711 Church Ave., Cleveland 13, Ohio, has brought out a new zinc die-casting machine designed to eliminate the human element, as far as possible, in setting up and adjusting the machine. The gooseneck is located or positioned by two machined slots in the yoke in such a manner that misalignment is impossible. Fixed to the goose-

To obtain additional information on equipment described on this page, see lower part of page 226.

neck is a splined bronze bushing which serves as an accurate, positive guide for the plunger stem. The head of the plunger is held by a T-slot coupling which is attached to the plunger cylinder, so that the plunger is completely self-aligning.

Two dog-point screws, acting against the bracket, provide the only adjustment needed for seating the gooseneck firmly against the nozzle. One of the features of this machine is the melting pot, which is entirely separate from the machine, and can therefore be made of any desired size. Rigid piping is provided for the oil lines to and from the plunger cylinder.

The machine is made with a plunger stroke of 6 1/2 inches, and in four plunger diameter sizes ranging from 2 to 2 3/4 inches, giving capacities for zinc castings ranging from 4 to 8 pounds per shot. Pressures range from 2450 to 1300 pounds per square inch. The machine is 13 feet 9 inches long, 3 feet 10 inches wide, and weighs 14,500 pounds. ----------72

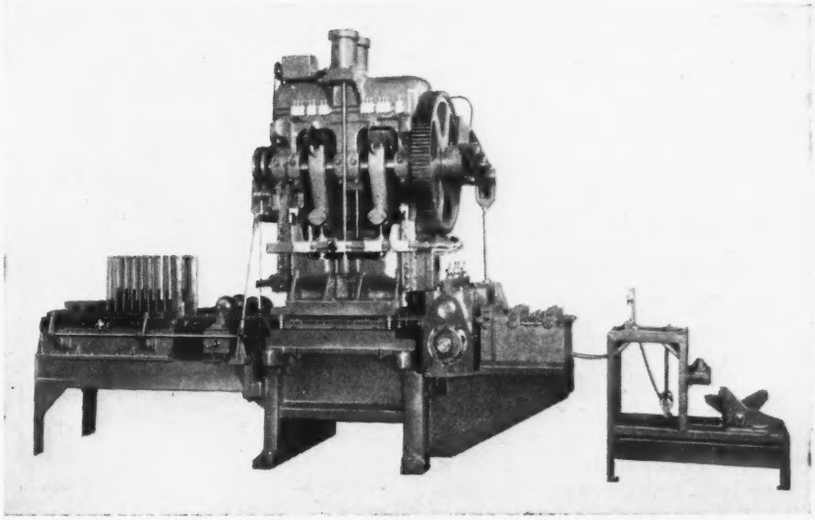


Fig. 1. Cleveland double-crank press equipped with uncoiler, roll feed, and stacker

Cleveland Press Equipped for Producing Radiator Fins

A double-crank gap type press equipped with uncoiler, roll feed, and stacker has been built by the Cleveland Punch & Shear Works Co., Cleveland 14, Ohio, for use in the production of radiator fins. The complete machine is illustrated in Fig. 1, while a close-up view of the stacker and two of the finished radiator fins is shown in Fig. 2.

The press is single-geared and provided with a single-station, electrically controlled Cleveland drum type air friction clutch. Two strips of material, 2 1/4 to 3 1/4 inches wide and 21 to 35 inches long, are pulled through the beading and corrugating rolls by means of the automatic roll feed, and are then passed through the feed rolls into the press, where they are punched and sheared to length.

The finished pieces are automatically delivered by rotating brushes to the stacker, where they are stacked, from the bottom up, in two separate piles by an elevator, which raises the stacks to permit a series of fingers to position the next pieces. The stacks of finished pieces can be readily removed from the stacker without interfering with the operation of the press.

The press slide has a stroke of 1 1/2 inches and an adjustment of 3 inches. The distance from the bed to the slide at the end of the down stroke, with the adjustment up, is 13 inches. The slide face is 22 by 32 inches, and the bed area is 22 by 44 inches. The press has a capacity of 60 tons, and operates at a speed of 45 to 90 strokes per minute. ----------73

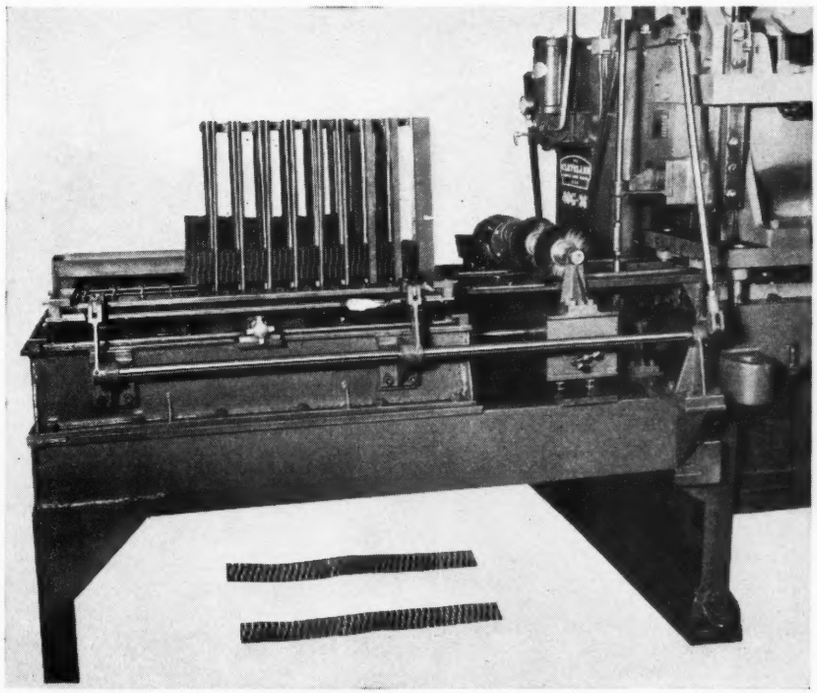


Fig. 2. Close-up view of stacker shown in Fig. 1, with two finished pieces of work in the foreground

Small Carbon Steel Taps

Increased life and more precise threads are advantages claimed for a new line of taps recently introduced by Woodruff & Stokes, Quincy 69, Mass. These taps are available in standard or special sizes up to No. 2 (0.086 inch) with up to 260 threads per inch. The threads and flutes of the taps are highly polished to reduce drag and fatigue. Radial chamfer of

To obtain additional information on equipment described on this page, see lower part of page 226.

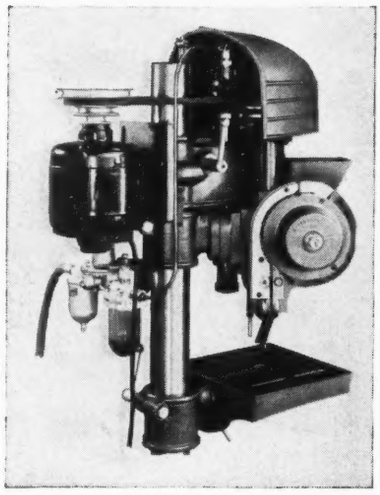
the cutting edges gives increased strength and extra chip clearance. In addition, special heat-treating methods have been developed which produce an extremely hard cutting edge. 74

Sebastian Lathes with Extra Long Beds

Sebastian 20-inch geared-head lathes manufactured by the King Machine Tool Division, American Steel Foundries, Cincinnati 29, Ohio, are now being produced in both general-purpose and gap types with beds up to 20 feet long. These lathes are designed to handle a full range of work, including long light pieces usually machined on precision heavy-duty lathes.

Sebastian lathes are also manufactured in 12- and 16-inch, as well as 20-inch sizes, in general-purpose, clutch and brake, and lineshaft drive types. In addition, gap and metric-screw types are made in 16- and 20-inch sizes.

All these lathes are equipped with eight-speed geared heads having Timken tapered bearings on the headstock shafts and Timken precision bearings on the spindle. Other features include reverse in apron for feeds; knob control handle for apron length friction feed; and fifty-four feed and thread changes. 75



Power screwdriver brought out by Shakeproof, Inc., Division of Illinois Tool Works

Shakeproof Power Screwdriver

A power screwdriver recently introduced by Shakeproof, Inc., Division of Illinois Tool Works, 2501 N. Keeler Ave., Chicago 39, Ill., has been specifically designed for use in high-speed mass-production lines. It features hopper feeding, driving speed of more than one screw a second in the smaller sizes, uniform tightening torque, and a minimum of "down time" for changing set-ups.

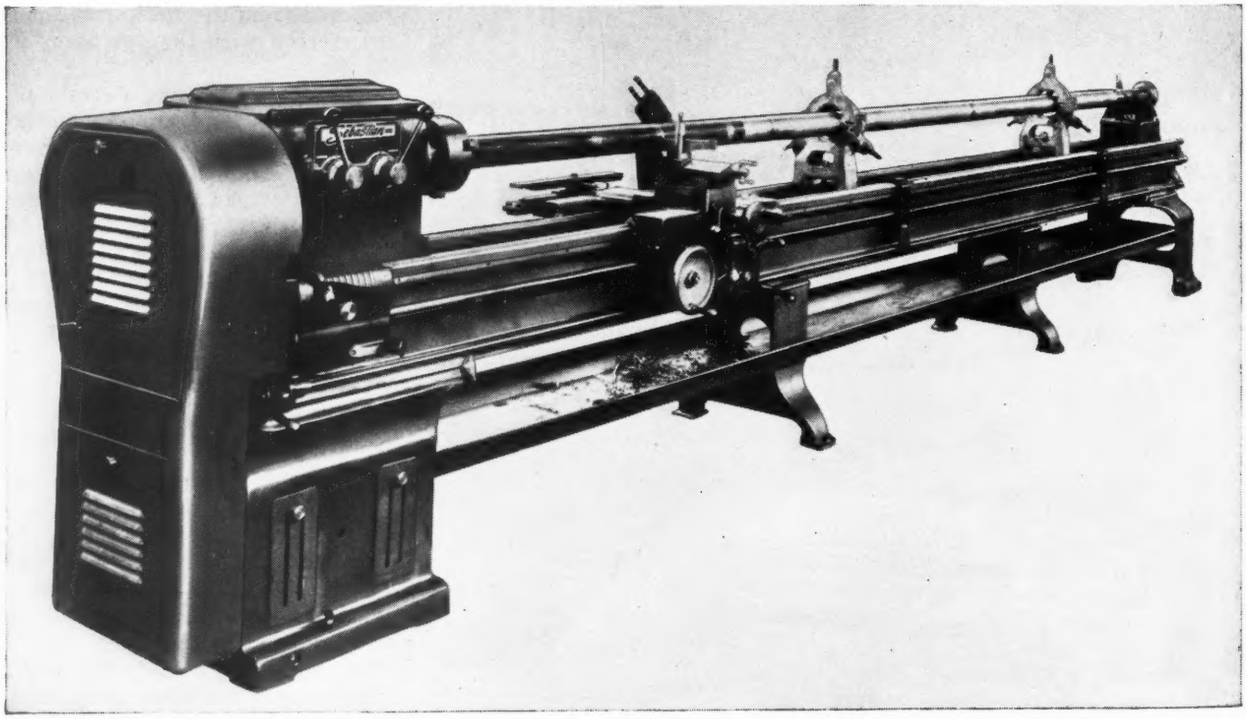
Practically all types and styles of screws in sizes ranging from No. 1 by 1/8 inch to 1/4 by 3/4 inch are readily accommodated by the specially designed hopper and driving spindle. Installation of the unit consists of merely plugging in to a 110-volt outlet and making connections with the compressed air supply line.

Operation of the new screwdriver consists of placing the screws in the hopper, locating the part to be fastened beneath the driving spindle, and lightly pressing the air-pedal to complete the driving of the screw. As the desired torque is reached, the clutch disengages automatically.

The machine weighs only 240 pounds, and occupies a floor space of 21 by 24 inches. 76

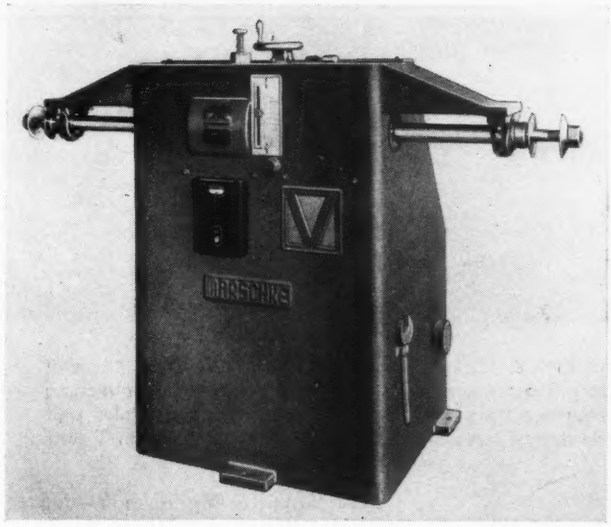
Vonnegut Buffing and Polishing Machine

A buffing and polishing machine with an underslung spindle has been added to the Marschke line of grinding and buffing machines built by the Vonnegut Moulder Corporation, 1819 Madison Ave., Indianapolis 25, Ind. The underslung design of this machine provides unusual rigidity for a relatively long, thin spindle, as the bearing support is entirely above the spindle and does not restrict



Sebastian geared-head lathe with extra long bed, built by the King Machine Tool Division, American Steel Foundries

To obtain additional information on equipment described on this page, see lower part of page 226.



Buffing and polishing machine developed by the Vonnegut Moulder Corporation

"Meritool" threading attachment announced by Motch & Merryweather

the depth or width of the overarm. It can be as massive as required to obtain proper support for the end bearings, which can be located immediately adjacent to the wheel flanges with minimum spindle overhang.

This design also permits locating the motor and power transmitting members to the best advantage. A larger bearing support arm can be furnished for longer spindles if needed to meet special requirements. The machine is built with one or two spindles, in various sizes having motors ranging from 1 to 30 H.P. 77

Machine for Producing Cams without Lay-Outs

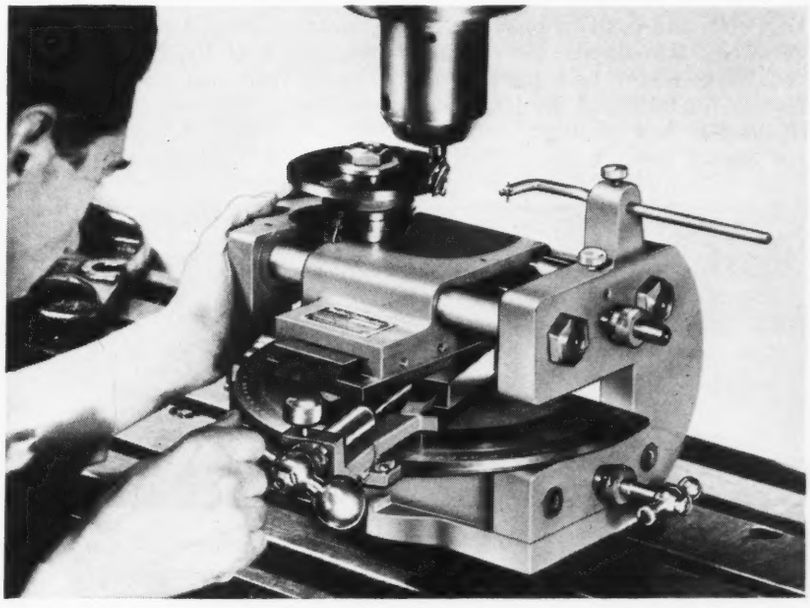
The Sheffer Collet Co., Traverse City, Mich., has brought out a new machine called the "Helix-Master," which is designed to produce mathematically correct cams without lay-outs. This machine is said to be especially adapted for the rapid production of accurate cams for automatic screw machines. It is entirely self-contained, and can be mounted on a milling machine, grinder, or drill press.

In cutting or laying out a cam on this machine, the cam blank is placed on the spindle with the spindle dial set at zero. If the first lobe is to have a rise of 0.010 inch per one-hundredth section for twelve one-hundredth sections, the selector arm is simply set at 10, and twelve divisions are spaced off on the spindle dial. The setting thus made is then locked and the feeding movement started by turning the lead-screw. After the first lobe is completed, the correct setting for the second lobe is made and the same procedure repeated.

Provision is made for employing the "Helix-Master" to scribe the outlines of mathematically correct cams on the cam blanks, so that they can be rough-machined close to the finished size by roughing cuts on a heavy machine tool. While cams can be machined on the "Helix-Master" directly from large size blanks, it is preferable to have the blanks rough-machined fairly close to the finished outline before the final cam profiling operation. 78

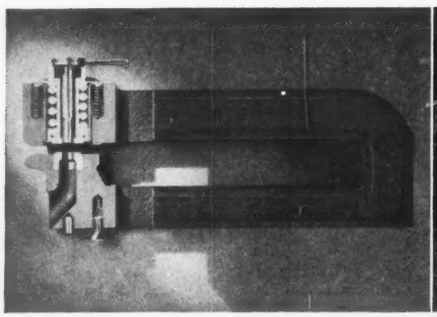
Threading Attachment

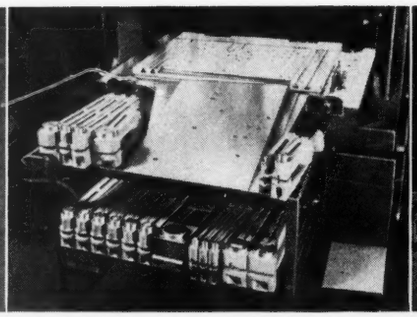
External or internal thread chasing can be performed easily with the "Meritool" lathe attachment recently announced by the Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, Ohio. This attachment automatically retracts the lathe tool from the work at any desired setting, and simplifies chasing of precision threads. It also permits small or large lot production to be handled on an ordinary lathe with repeatable accuracy. The tool can be quickly mounted on any 9- to 14-inch capacity V-way lathe..... 79



"Helix-Master" developed for laying out and producing mathematically correct cams

To obtain additional information on equipment described on this page, see lower part of page 226.





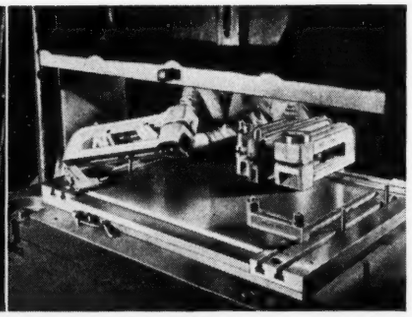
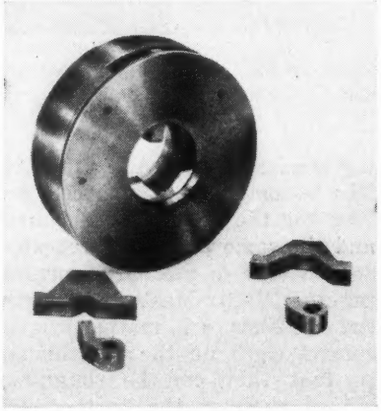


Fig. 1. (Left) Cut-away view of Wales hole-punching unit. Fig. 2. (Center) Four elements of Wales sheet-metal perforating equipment, consisting of T-slotted mounting base; master templet; set-up templets; and hole-punching units. The master templets are interchangeable in the mounting base. Fig. 3. (Right) Mounting a Wales unit on a set-up templet which, in turn, is located on top of the master templet. The units are bolted down in T-slots

Wales Sheet-Metal Punching and Notching Units

A new system of perforating and notching sheet metal, developed especially for fast, efficient fabrication, has been announced by the Wales-Strippit Corporation, 345 Payne Ave., North Tonawanda, N. Y. In this system, Wales self-contained units, such as shown in Fig. 1, are used for perforating and notching. A master templet, placed on the press bed, as shown in Fig. 2, has pilot-pin holes located over the entire surface in the same pattern as the perforations in the finished piece.

Set-up templets, marked with the operation number and punch size, are placed on top of the master templet to identify the pilot-pin holes to be used in each operation. The number of operations on each part depends on the quantity, size, and position of the perforations. An engineering change requiring a new hole location is merely a matter of locating and drilling a new pilot-pin hole on the master templet. 80



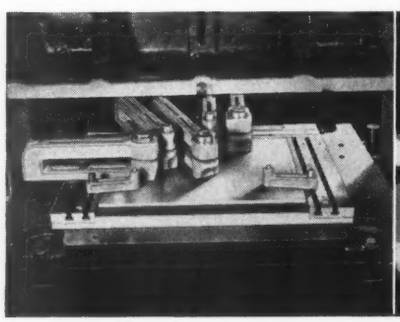
Automatic work-driver and jaws brought out for use on Monarch lathes

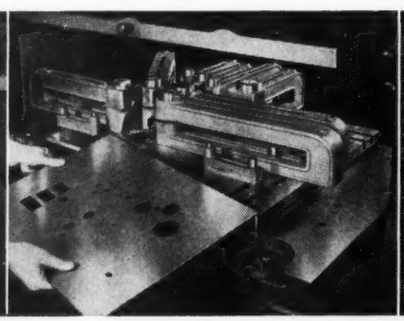
Automatic Work-Driver for Monarch Lathes

An automatic work-driver of the serrated-jaw type has just been announced by the Monarch Machine Tool Co., Sidney, Ohio. This driver has been designed specifically for use on Monarch lathes having a 6-inch Type D-1 or Type A-1 spindle nose. It is applicable to Monarch Series 60 engine and toolmaker's lathes for production operations such as those utilizing the "Air-Gage Tracer" or "Motor-Trace" controls; and to "Mona-Matic" and "Uni-Matic" lathes.

When the spindle is started, a lever-actuated jaw clamps the work so that the heavier the cut, the harder the pull of the driver. If the spindle is stopped quickly, the driver opens automatically. However, when the spindle is gradually brought to a stop, it is necessary for the operator to rotate the outer portion of the driver slightly to free the work.

This automatic work-driver is supplied with two sets of standard jaws. One set has a capacity of 1 inch to 2 1/4 inches, and the other of 2 1/4 to 3 1/2 inches. A third set of jaws having a capacity of 1/2 inch to 1 1/4 inches is also available. The various sets of jaws are interchangeable, and each set is adjustable over its entire range. Since the jaws are of the floating type, they will compensate for a reasonable amount of eccentricity. 81





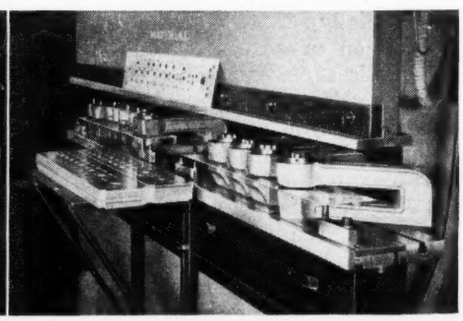
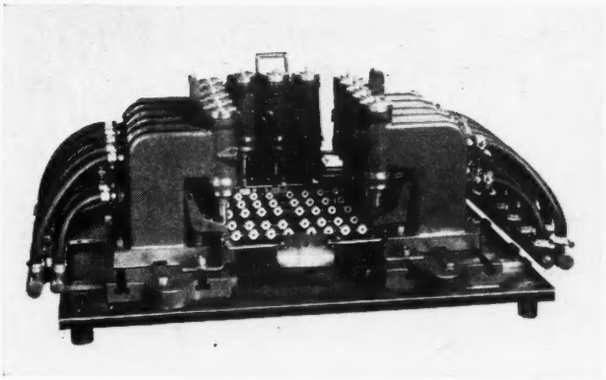
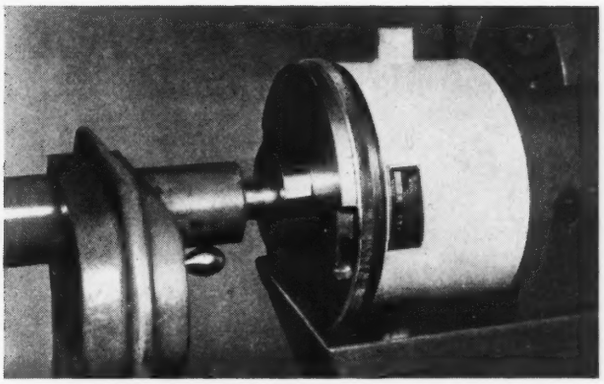


Fig. 4. (Left) Set-up of Wales units ready to operate with the first down stroke of the press ram. The uniform shut height of the units permits only one ram adjustment, regardless of the number of set-ups. Fig. 5. (Center) Set-up of Wales units that perforate the many holes shown in the finished work in the foreground. Note pick-up pins used to locate the part accurately. Fig. 6. (Right) Two set-ups of hole-punching units that complete series of holes previously punched in piece shown above punching units. Note strip templet in bed rail with pilot holes for locating units. The T-slot in bed rail is used to bolt units securely to rail

To obtain additional information on equipment described on this page, see lower part of page 226.



Special multiple-head riveting machine manufactured by the Hill Machine Co.



Air cylinder for operating collet chucks and mandrels, made by Erickson Tools Division

Hill Multiple-Head Pneumatic Riveters

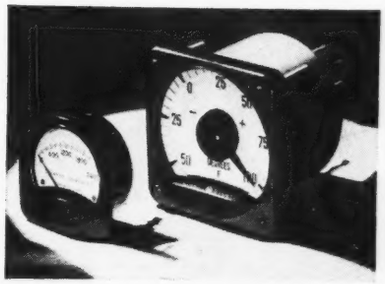
Special multiple-head pneumatic riveting machines utilizing standard heads arranged to suit specific jobs have been added to the line of riveters manufactured by the Hill Machine Co., Box 677C, Rockford, Ill. The heads used on these riveters can be spaced as close as 2 3/4 inches between centers.

Air for operating these riveters is controlled by a single solenoid-operated air valve through a foot switch used in conjunction with an adjustable timer which limits the time of the riveting cycle. A pressure reducing valve is also provided. By adjusting the air pressure and the riveting time, the desired peening effect can be accurately controlled. The special machine shown in the illustration has thirteen heads. 82

General Electric Temperature Indicators

A new line of temperature indicators for industrial and laboratory use has been announced by the General Electric Co., Schenectady 5, N. Y. Included in the line are cold-end compensated thermocouple thermometers for measuring temperatures up to 3000 degrees F., and resistance thermometers for temperatures up to 300 degrees F.

The thermocouple thermometer is available in two sizes, Type DO-71 with a 3 1/2-inch flange, shown at the left in the illustration, and the DW-71 with a 2 1/2-inch flange (not shown). Both types can be supplied with square or round molded Textolite cases. The thermocouple thermometer is applicable for measuring temperatures in galvanizing vats, melting pots, industrial furnaces, infra-red drying ovens, oil quenching baths, salt annealing baths, etc.



(Left) General Electric thermocouple thermometer and (Right) resistance thermometer

The new resistance thermometers, designed for the measurement of low temperatures where high accuracy is important, are suitable for bearing temperature measurement, generator- and transformer-winding temperature indication, refrigeration and air-conditioning testing, drying operations, remote fluid-temperature indication, and scientific laboratory work. 83

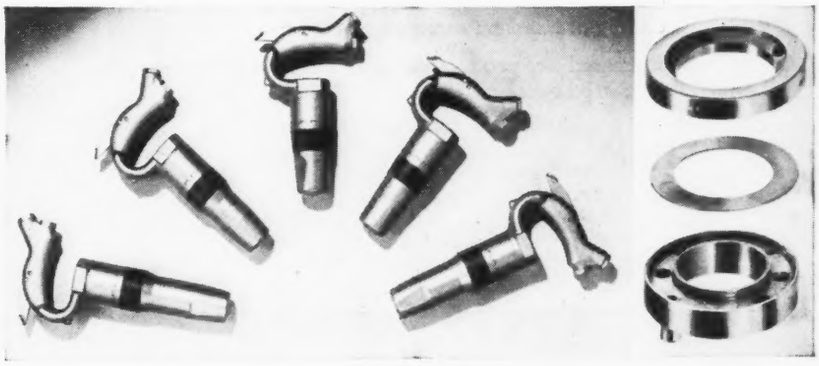
Erickson Air Cylinder

The Erickson Tools Division, 2311 Hamilton Ave., Cleveland 14, Ohio, has brought out a new air cylinder applicable to collet chucks and expanding mandrels, which uses the mechanical advantage of levers or dogs to give increased gripping power. The piston is of the "doughnut" design, which permits bar stock and work to be passed through the unit. It has a movement of 1/8 inch in either direction, and can be used for either push or pull type mechanisms. 84

Chipping Hammers

The Rotor Tool Co., 17325 Euclid Ave., Cleveland 12, Ohio, has announced a new line of "Multi-Power" chipping hammers designed to provide fifteen different combinations of feed, stroke, and impact. This wide range of hammer performance permits the user to select the chipper best suited to his work.

The design of the entire line of hammers is based on five funda-

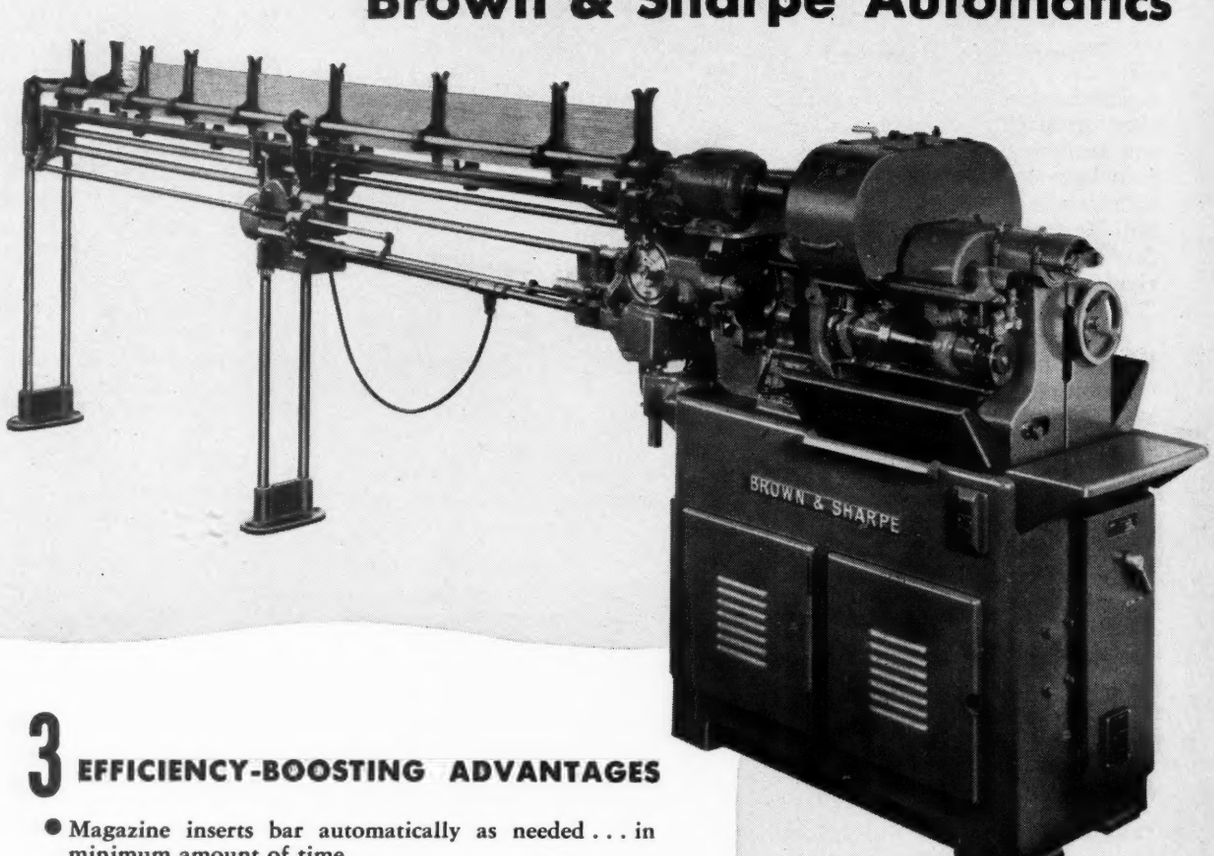


(Left) Basic models of new line of pneumatic chipping hammers brought out by Rotor Tool Co. (Right) "Doughnut" type valve used in chipping hammers

To obtain additional information on equipment described on this page, see lower part of page 226.

Boost net output per machine

Install AUTOMATIC ROD MAGAZINES on your Brown & Sharpe Automatics



3 EFFICIENCY-BOOSTING ADVANTAGES

- Magazine inserts bar automatically as needed . . . in minimum amount of time.
- Greatly simplified restocking provides ample time for operator to supervise quality and finish of work more closely . . . and on more machines.
- Increased net production more nearly approaches gross or geared output.

BROWN &

BETTER WORK — LOWER COSTS

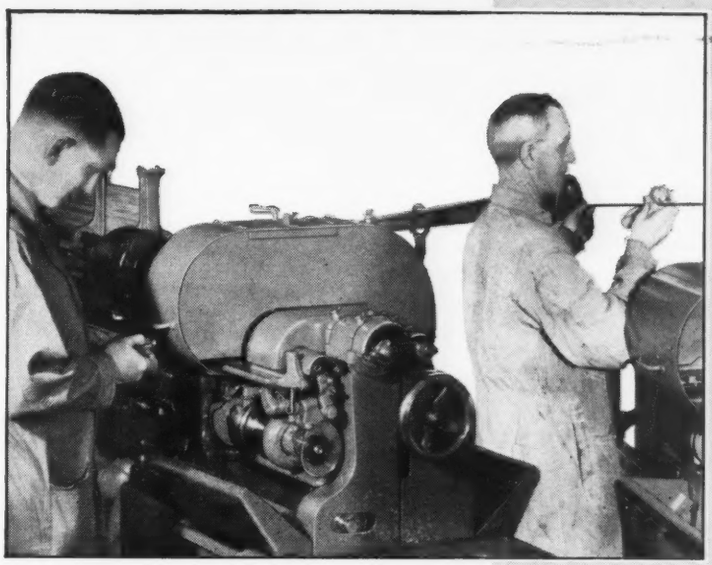
With the Automatic Rod Magazine, a screw machine operator is free to check work pieces more frequently and to pay closer attention to tool conditions . . . maintaining desired quality and producing parts at a minimum cost.

INCREASED OPERATING EFFICIENCY

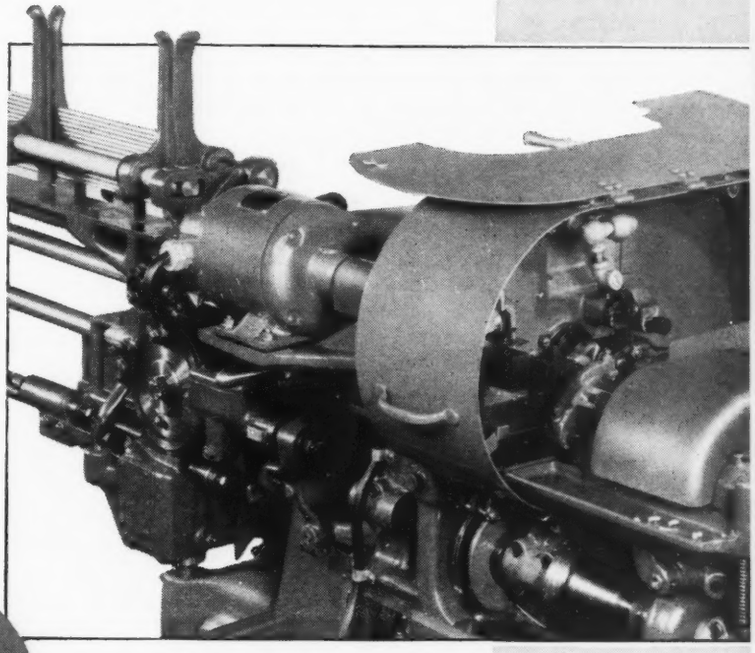
Here's how the Brown & Sharpe Automatic Rod Magazine increases operating efficiency. (1) The magazine permits loading of stock at any time (2) The feeding mechanism takes a new rod automatically the instant it's needed and feeds it into position for trimming.

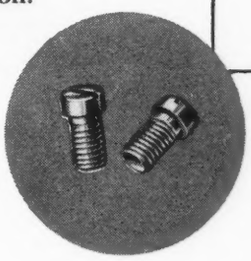
Electrically-controlled magazines are made for Brown & Sharpe Nos. 00G and 0G Automatic Screw and Cutting-Off Machines . . . also for Automatic Screw Threading Machine. Mechanically-operated magazine is made for No. 2G Machine. Magazines take commercial 10 ft. bars; 12 ft. capacity available.

Investigate the production advantages of Automatic Rod Magazines for your plant. Send for complete information. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.



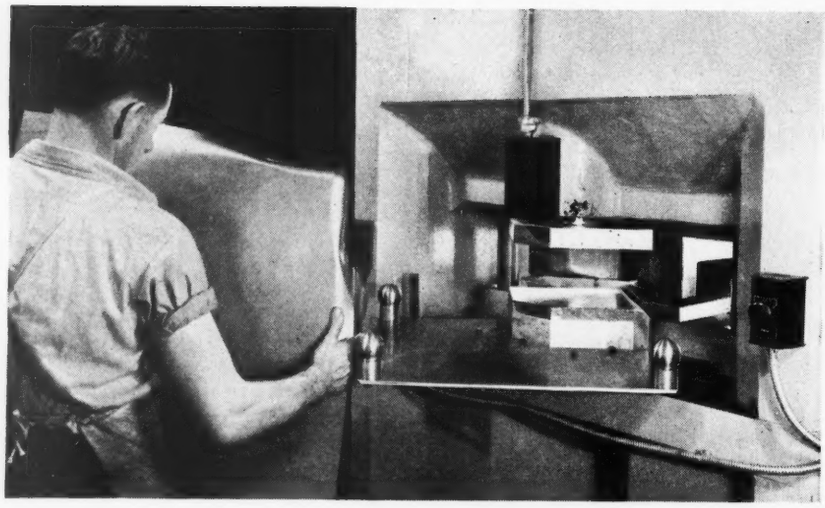
Compare the value of these screw machine operators. In foreground, operator utilizes his skill to full capacity because his machines are equipped with Automatic Rod Magazines that require infrequent stocking. Other operator must spend much of his time restocking — less time on tool maintenance and quality of work.





Every 3½ minutes this Automatic Screw Threading Machine consumes a 10 ft. bar, ¼" diam., in making screws like those shown at left. Its Automatic Rod Magazine holds 33 of these bars — two hours' supply. Magazine can be reloaded any time during this period. Without magazine, reloading involves over 15 interruptions an hour, making operation of more than two machines and close work-supervision difficult for one operator.

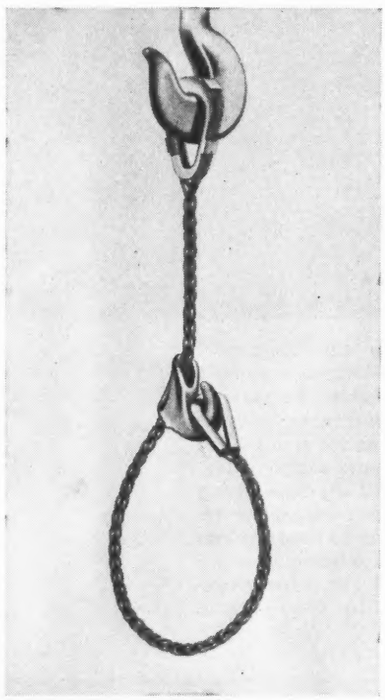
SHARPE B·S



Hydraulic drawing press designed to draw one corner of work at a time, developed by the Vulcan Tool Co.

mental models with piston strokes of 1, 1 1/2, 2, 2 1/2, and 3 inches. Each of these sizes is readily adjustable to three combinations of speed and force of blow. A high degree of interchangeability of the component parts serves to cut down maintenance costs and reduces the number of parts which must be kept in stock.

The "doughnut" valve used in these chipping hammers (see view at right in illustration) is said to be an outstanding improvement over the valves formerly employed. It is claimed that valve breakage has been eliminated by the use of this new design, and that the valves have made possible substantial reductions in the weight and over-all length of the hammer. The smallest hammer has a piston stroke of 1 inch, weighs 10 1/2 pounds, and is only 10 3/8 inches long; the largest hammer has a 3-inch piston stroke, weighs 13 7/8 pounds, and is 13 7/8 inches long. ----------85



Bethlehem single-leg choker sling with multiple-part braided rope legs and sliding choker hook

Bethlehem Steel Wire Rope Slings and Fittings

Steel wire rope slings and fittings developed to facilitate the safe and rapid handling of materials and products ranging from small machine parts to complete locomotives are being made by the Bethlehem Steel Co., Bethlehem, Pa., at the company's Williamsport plant. "Purple Strand" wire rope, which combines great strength with high resistance to wear and fatigue, is used in this complete line of slings to assure maximum durability and safety.

About eighty different slings having distinctive fittings or combinations of fittings of exact specifications are available. The complete line includes simple grommet slings made from one continuous strand of wire rope 3/8 inch in diameter up to slings using wire ropes 2 3/4 inches in diameter and capable of handling loads up to 175 tons.

Braided slings, such as the one shown in the illustration, are especially designed to meet the needs of a large number of industries for a safe and economical type of sling for many different uses. Outstanding features of this sling are flexibility and resistance to kinking. ----------86

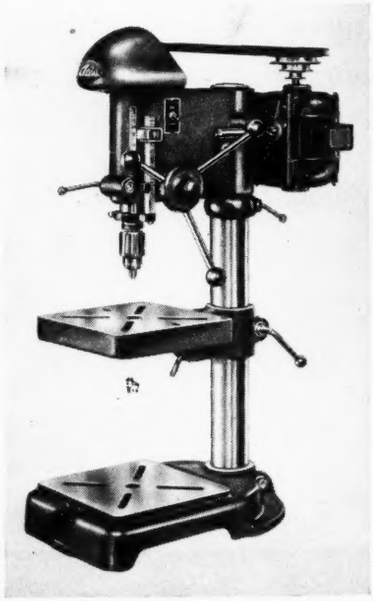
Vulcan Corner Draw Press

The Vulcan Tool Co., 730 Lorain Ave., Dayton, Ohio, has announced the development of a hydraulic drawing press which is designed to draw one corner of a part at a time. This press, known as the "Vulcan-Draw," is especially adapted for use in the fabrication of panels where the production schedule is not high and where a variety of sizes are manufactured.

In operation, the flat sheet is placed in position with one corner in the draw die. The operator then steps on an actuating pedal. In a few seconds, the hydraulic cycle is completed and the sheet is released with the corner completely drawn and finish-sized. The other corners are then formed in a similar manner, the over-all panel dimensions being held to size. Side- and end-bending operations performed in the regular type of press brake complete the forming of the panel. ----------87

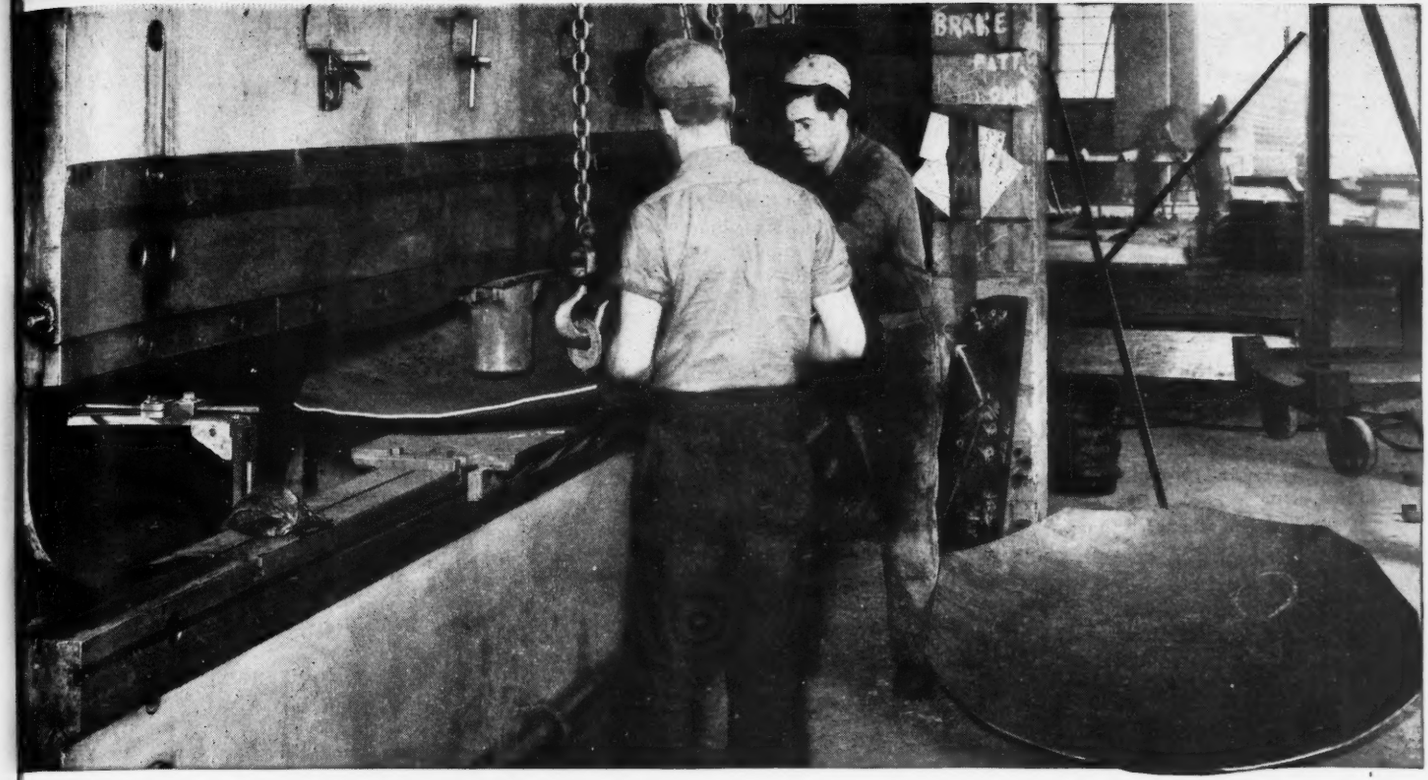
Atlas Drill Presses

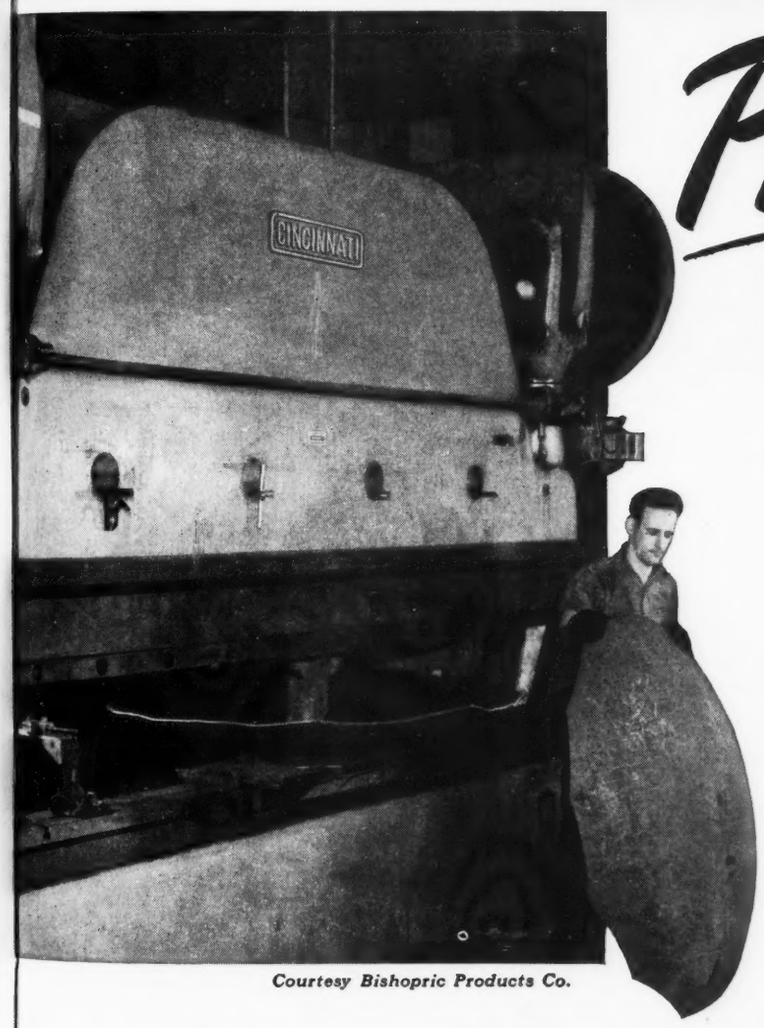
A new 15-inch drill press, available in high- and low-speed models, has been announced by the Atlas Press Co., 2353 N. Pitcher St., Kalamazoo, Mich. This drill



Drill press brought out by the Atlas Press Co.

To obtain additional information on equipment described on this page, see lower part of page 226.





Courtesy Bishopric Products Co.

Profitable VERSATILITY

for JOBBING WORK!

Cincinnati All-Steel Press Brakes are used profitably for bending, punching, press work and a great variety of jobbing applications.

Dished heads, a common problem in the tank field, are being formed on this Cincinnati Press Brake in a range of sizes with simple low-cost dies and without change in setup.

This Cincinnati Press Brake, with equally low-cost tooling, simplifies difficult sheet metal and plate jobs and is a versatile, profitable and busy tool in any fabricating shop.

Write for Cincinnati Press Brake Catalog B-2A.

CINCINNATI

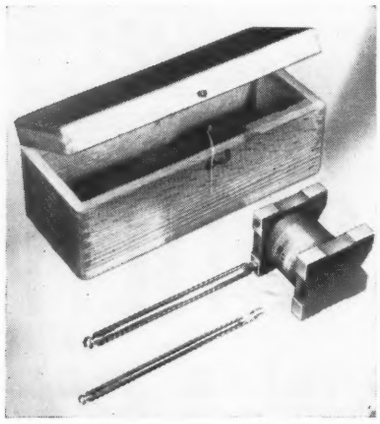
THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

press can be had in either a floor or bench type, and with a production base and two, three, or four spindles. It is equipped with a full tilting or production oil table, Jacobs chuck, or No. 1 or 2 Morse taper spindle.

Outstanding features of the machine include a new floating drive with splined spindle and steel drive sleeve supported by two ball bearings; ground steel spindle supported by two widely spaced ball bearings; ground steel quill; new head casting designed for greater rigidity; and extra heavy head, column, and base. The bench type machine drills to the center of a 15-inch circle at nine speeds ranging from 400 to 4400 R.P.M.; has a 4-inch spindle travel; 12-inch maximum table to chuck distance; 16-inch maximum base to chuck distance; 10- by 10-inch table; and is driven by a 1/3- or 1/2-H.P. 1725-R.P.M. motor....88

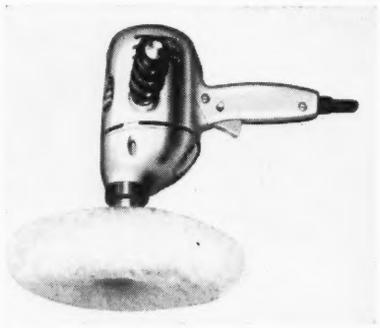


"Minute Man" Magnetic Base for Dial Indicator

"Minute Man" magnetic base designed for quick, convenient application of dial indicator gages and other tools. There is a V-slot in one side of the base to permit attachment to round as well as flat surfaces. Interchangeable brass shafts 7/32 and 5/16 inch in diameter are provided for attaching the dial indicator gage or height gage. The base has a 40- to 50-pound grip on all four sides, and its holding power does not diminish with service. Introduced by the du Mont Corporation, Greenfield, Mass. 89

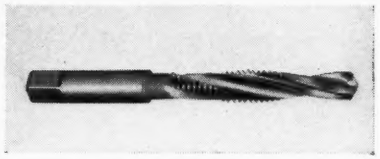
Van Dorn "Junior" Polisher

New 7-inch "Junior" electric polisher introduced by the Van Dorn Electric Tool Co., Towson 4, Md. This polisher, which weighs only 8 pounds, is especially designed for intermittent service in small shops and garages. It has a reversible auxiliary side handle for either right-hand or left-hand use. A spindle-locking pin provides for quick changing of bonnets and pads. The side handle has a trigger switch with switch-locking pin for continuous operation. The universal motor operates on either alternating or direct current, and has a no-load speed of 2000 R.P.M. 90



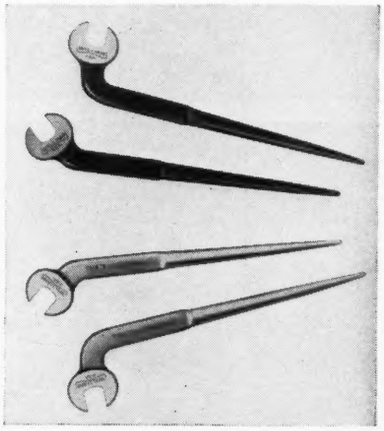
Sub-Land Combination "Drill-Tap"

Precision tool designed to drill and tap in one operation. Adapted for use on through-hole work only, such as drilling and tapping flanges. The drill, on completing the hole, serves as a pilot for starting the tap. When drill becomes dull and end sharpening is necessary, the tapping flutes are ground off an equal amount to retain drill clearance. These grinding or sharpening cuts are taken the entire length of the flutes and can be repeated as required. Available in sixteen drill sizes ranging from 0.201 inch to 0.6875 inch, with taps from 1/4 inch to 3/4 inch in National coarse and National fine thread types. Manufactured by the Mohawk Tool Co., 21647 Dequindre Road, Hazel Park, Mich.....91



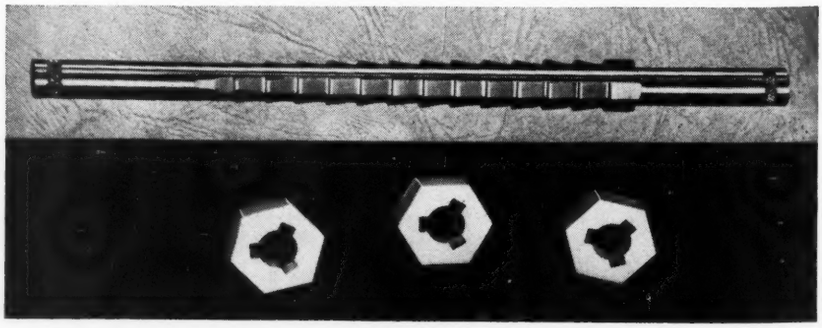
Williams Construction Wrenches

New line of 45- and 90-degree bent-handle construction wrenches in both carbon and alloy steels made in a complete range of sizes and styles by J. H. Williams & Co., 400 Vulcan St., Buffalo 7, N. Y. The bent handles of these wrenches facilitate work in close quarters where maximum leverage is required. Openings range from 7/8 inch to 2 inches. 92

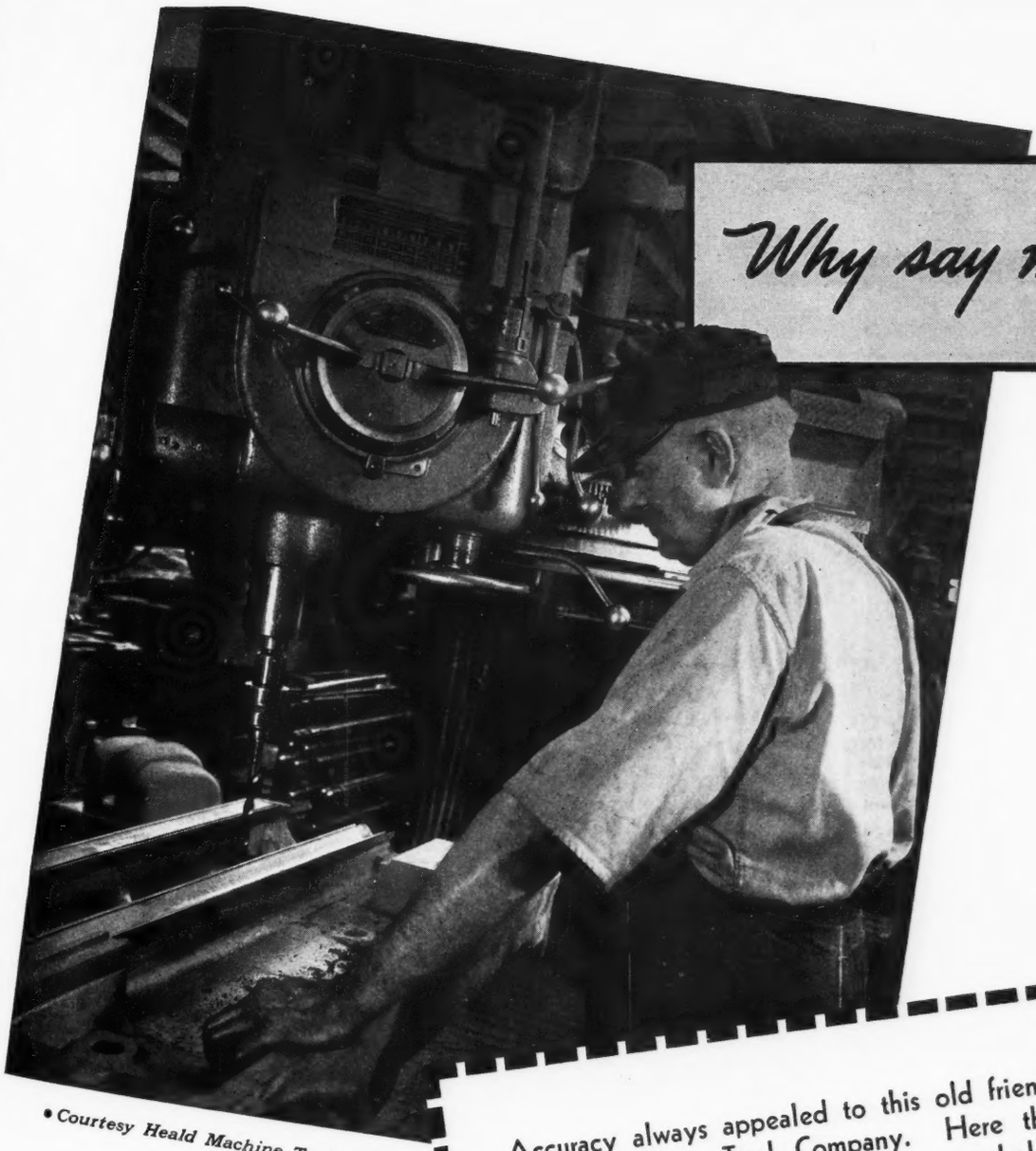


Glenny Broach Designed to Cut Three Keyways in a Single Pass

Glenny push type broach developed by the Kase Machine Co., 18429 Buffalo Ave., Cleveland 19, Ohio, to cut three keyways in a work-piece in a single pass of the tool. This broach has blades that are interchangeable as well as adjustable for depth of cut. It can be used to cut one, two, or three keyways in pieces such as those seen in the lower view. These broaches can be furnished in sizes ranging from 5/16 inch to 1 1/2 inches. Blade widths range from 1/16 to 3/8 inch, depending upon the broach diameter. Designed for use on hydraulic, air, and hand-operated presses. 93



To obtain additional information on equipment described on this page, see lower part of page 226.



Why say more?

• *Courtesy Heald Machine Tool Company*

Accuracy always appealed to this old friend—The Heald Machine Tool Company. Here they are boring, facing and reaming numerous holes in a 1360-lb. casting.

They say, and we quote: "We bought this Cincinnati Bickford Super-Service Radial Drill to increase war-time production. We also have ten large and a flock of smaller ones. Why say more?"

Cincinnati Bickford Super-Service Radial Drills are always accurate, dependable tools, highly productive and profitable in the shop.

Write for Bulletin R-24A.

See our condensed Catalog in Sweet's File.

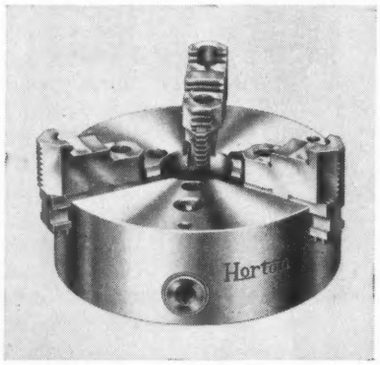
RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

Equal Efficiency of Every Unit Makes the Balanced Machine

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.

Horton Chucks with Flame-Hardened Jaw Ways

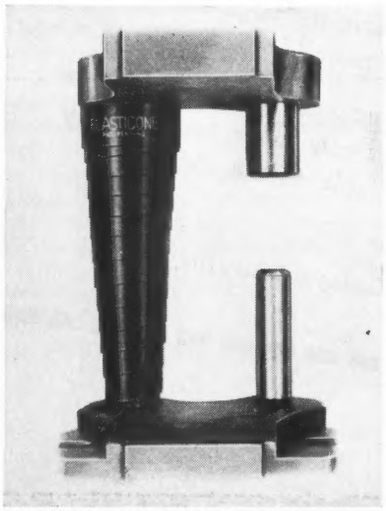
Lathe chuck with flame-hardened jaw ways brought out by the E. Horton & Son Co., Windsor Locks, Conn. The jaw ways are subjected to a new method of flame-hardening which does not affect the accuracy of the chuck body. Since the jaw ways have always been the most vulnerable wearing point

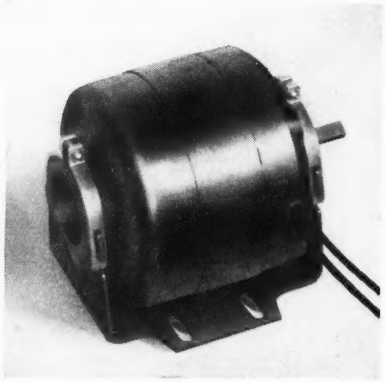


of the chuck body, this flame-hardening treatment serves to prolong the life of the chuck and to maintain its initial accuracy and gripping power. 94

Elasticone Guard for Die Guide Pins

Punch press operators are safeguarded from injury and die sets are protected against excessive wear and damage by the new Elasticone guide-pin cover here illustrated, which has just been introduced by the Central Safety Equipment Co., Philadelphia 25, Pa. This guard entirely encloses the pin and bushing area. Made in sizes suitable for punch press die sets with bushing diameters ranging from 1 1/2 to 6 inches and with open heights ranging from 4 to 24 inches. 95





Lifetime-Lubricated, Unit-Bearing Motor for All-Angle Operation

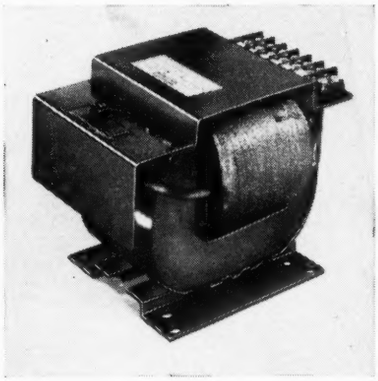
Lifetime oil-lubricated, shaded-pole motor designed for operation in any position—with shaft up, down, horizontal, or at any intermediate angle. This new Type KSP motor, announced by General Electric Co., Schenectady 5, N. Y., is made in frame sizes 11 and 21 with a variety of mountings. It can be used to drive fans, coolers, unit heaters, small pumps, agitators, and blowers. Available in either open or totally enclosed types. Ratings range from 1/40 H.P. through 1/12 H.P. at 115 or 230 volts, 1050 or 1550 R.P.M., 60 cycles. 96

Adapter Base Designed to Facilitate Grinding Carbide Tools

New adapter base designed to convert practically any bench grinder into an accurate carbide-tool grinding machine. This attachment, developed by E. F. Hager & Son, Queens Village 9, N. Y., makes available the same reciprocating action provided by the large Hager universal carbide grinder, and permits accurate grinding of right- and left-hand single-point carbide tools up to 1 1/4 inches high. Single-point tools of materials other than carbide can also be sharpened. The feed of the tool toward the grinding wheel is accurately controlled by feed-knobs graduated in 0.001 inch divisions. 97

Westinghouse Standardized Machine Tool Control Transformers

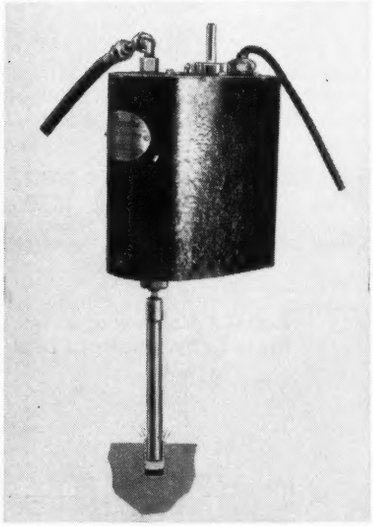
Machine tool control transformer designed to follow closely the proposed standards of the National Electrical Manufacturers Association. Announced by the Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. The transformers of the new line are particularly adapted to the inductive,



low power-factor loads of solenoids, relays, and contactors employed for machine tool control equipment. Secondary voltage of the 60-cycle transformers remains above 90 per cent of rated voltage up to a load current of seven times normal at 20 per cent load power factor. 98

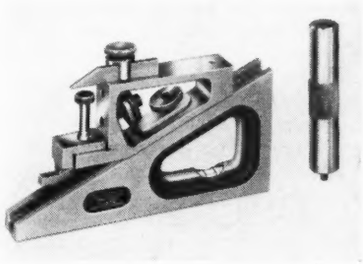
"Metalmaster Junior" Metal Disintegrator

Thomas "Metalmaster Junior" fast cutting metal disintegrator announced by the Clinton Machine Co., Metalmaster Division, Clinton, Mich. This compact, easily handled metal disintegrator can be adapted to any standard drill press. It can be employed for removing broken taps of 0.080 to 1 inch in diam-



To obtain additional information on equipment described on this page, see lower part of page 226.

eter from holes without distorting the threads, and can be used for cutting holes of any shape in dies or other hardened metal or carbide parts. 99

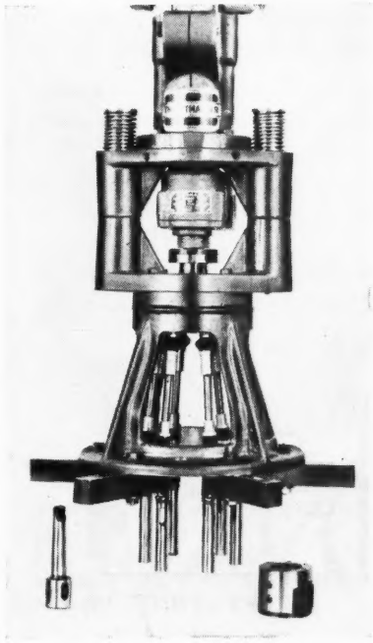


Starrett Universal Precision Gage with Fine Adjustment

Universal precision gage designed for gage-makers, tool- and die-makers, inspectors, and machinists. Quick, easy adjustment of a knurled thumb-screw permits setting this gage to the exact size required, either from a micrometer, height gage, vernier caliper, or gage-blocks. A clamp nut locks the slide in place. With the scribing attachment, the tool can be used as a surface or height gage. It can also be used as a planer and shaper gage or an adjustable parallel. The gage is approximately 3/4 inch wide by 5 1/4 inches long. Capacity, with both extensions, is 10 1/4 inches. Made by the L. S. Starrett Co., Athol, Mass. 100

Multiple-Spindle Drilling and Tapping Unit

Multiple-spindle drilling and tapping unit composed or a standard multiple-spindle adjustable drill head and a standard Dorman automatic reverse tapping attachment made by Thriftmaster Products Corporation, Division of Thomson Industries, Inc., 10 N. Plum St., Lancaster, Pa. Can be attached to any drill press and will drill or tap an infinite number of patterns. To change the hole pattern, spindle bracket bolts are loosened, spindles are set in desired position, and bolts are locked to hold spindles in required locations. 101

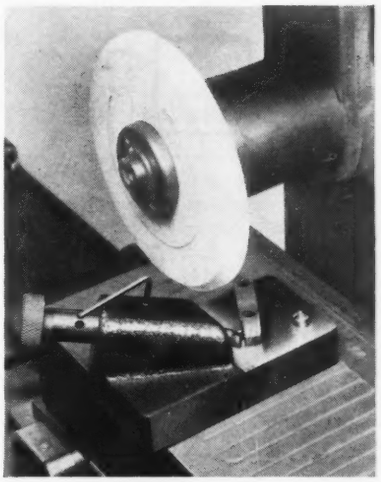


Pratt & Whitney Carbide Burrs

Carbide burrs brought out by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn., for removing excess metal when shaping and finishing all kinds of materials, particularly the tough steels used in producing modern dies and molds. To provide the operator with better control, especially in nose-cutting, the diamond-cut design of the Pratt & Whitney Keller carbide burr, known as "Di-Bur," has been further improved by deepening the flutes at specified intervals. Made in all regular shapes and sizes, and in fine, standard, and coarse cutting grades. 102

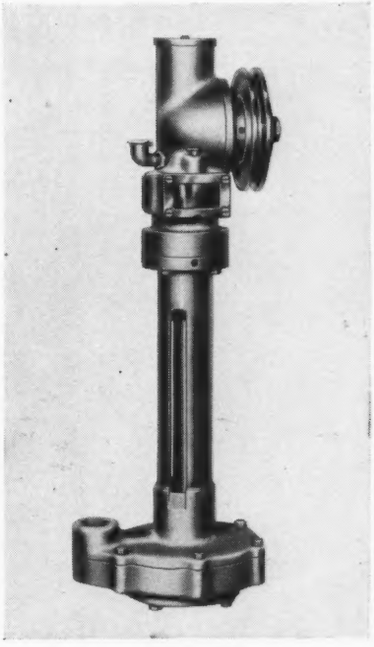
Sharpening Fixture for Single-Point Boring Tools

Sharpening fixture developed by the Bokum Tool Co., Detroit 21, Mich., to facilitate the sharpening of Bokum single-point boring tools. The fixture consists of a rectangular base which is placed on a magnetic bed at right angles to the wheel. The tool to be sharpened, after being put into a special adapter, is inserted into the inclined hole of the fixture until the cutting end rests against a carbide-tipped stop. A diamond wheel-dresser at one corner of the fixture serves as a guide in setting the wheel for the most efficient performance. 103

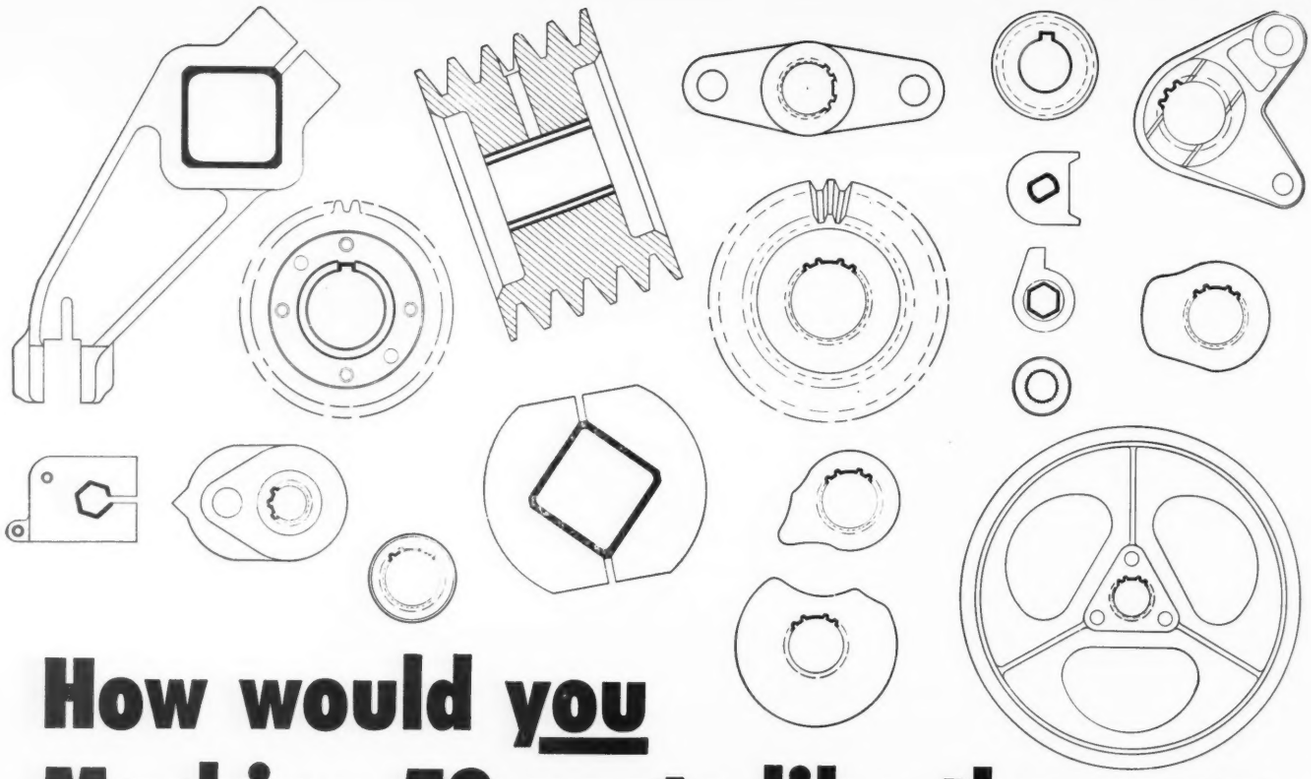


Ruthman Belt-Driven Gusher Pump

Belt-driven gusher pump designed for liquids that are difficult to handle and injurious to conventional type pumps. Can be furnished with flat belt or V-belt pulleys of various sizes. Capacities for handling water or soluble coolants range from 10 gallons per minute at 4-foot head and pressure of 3.85 pounds per square inch, with pulley speed of 500 R.P.M., to 44 gallons per minute at 4-foot head and pressure of 21.90 pounds per square inch, with pulley speed of 1200 R.P.M. Within the drive housing is an automatic lubrication system which is operated by a built-in small centrifugal pump adjacent to the oil window. Placed on the market by the Ruthman Machinery Co., 1807 Reading Road, Cincinnati 2, Ohio. 104



To obtain additional information on equipment described on this page, see lower part of page 226.



How would you Machine 59 parts like these ...in short runs?

Warner & Swasey does it by broaching —using only:

ONE machine—a Colonial 10-ton 54″ stroke Pull-down machine with automatic broach handling;

THREE base fixtures—designed and built by Colonial Broach Company;

. . . plus quick-interchangeable fixture adapters for the different parts.

By "designing for broaching," Warner & Swasey assured itself of both high precision and fastest possible metal removal.

Working with Colonial Broach engineers, Warner & Swasey added to this the benefits of low tooling, set-up, and change-over costs.

Whether mass production or job-lot runs are your problem, Colonial can show you the way to

"Do it for less"

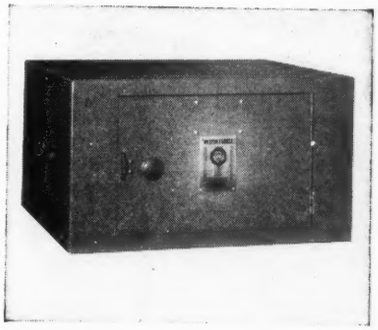
PIONEERS OF H.S.S. BROACHING

COLONIAL

BROACH CO. DETROIT 13

Westinghouse Sequence Weld-Timer

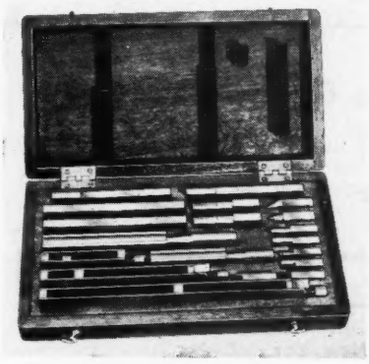
New sequence weld-timer designed to permit faster operation and more accurate sequence timing of non-synchronous resistance welders, as well as to provide easy low-range adjustment. This NEMA3B timer is contained in a wall-mounted sheet-steel enclosure arranged to facilitate servicing and adjustment of the time-setting dials. Designed for operation at a speed up to 450 spot-welds per minute on 20-gage



steel. Brought out by the Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. 105

Jansson Gage-Block Accessories

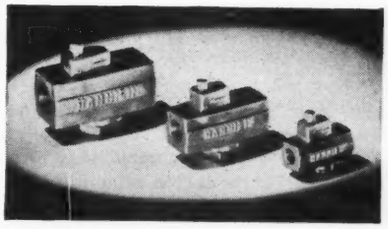
New set of accessories designed for use with all makes of precision gage-blocks, announced by the Jansson Gage Co., 19208 Glendale Ave., Detroit 23, Mich. This set makes possible a variety of additional applications of gage-blocks without the necessity of investing in numerous individual references gages. It includes jaws, straightedges, and adjustable holders in various sizes, as well as a center point and scriber. The jaws, used for assembling temporary limit



gages for external and internal measurement, are furnished in six sizes with over-all lengths ranging from 1 5/8 to 6 inches. Two straightedges of the four-blade type are included, which are said to be extremely accurate, the edges being straight to within 0.000004 inch per inch of length. 106

Hannifin Speed Control Valve

Speed control valve for use on pneumatic cylinders with pressures up to 150 pounds per square inch. A safety fea-



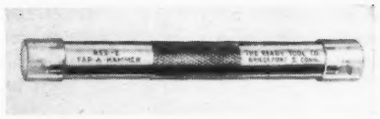
ture permits air to escape around the valve stem as a warning to the operator when the point of maximum adjustment has been passed. Then by a few reverse turns, the seal is restored, so that there is no danger that the valve stem will be removed while the air pressure is on. Made in 1/4-, 3/8-, 1/2-, and 3/4-inch pipe sizes by Hannifin Corporation, 1110 S. Kilbourn Ave., Chicago 24, Ill. 107

Ingersoll-Rand Controlled-Power Chipping Hammers

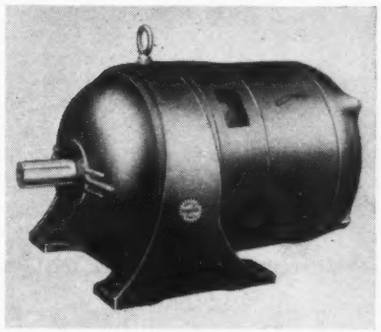
Controlled power chipping hammer brought out in fifteen power sizes with five basic hammer sizes by the Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y. Each hammer size is available in normal-cut, extra-cut, or super-cut type. Extra long operating life is insured by hard-facing pistons with "Iramet" and plating other wearing parts with this material. The new "Airite" air-control valve insures a smooth flow of full power, eliminating short stroking and loss of power on heavy cuts. 108

New Type Hammer

A unique new type hammer, known as the "Tap-A-Hammer," designed for work that requires a direct tap. Both



ends of this tool are made of a plastic material that is compressible and able to absorb the shock of the tap and cannot break or chip. The hammer is made of solid steel with a chromium finish and a diamond knurl in the center for a firm grip. Weight 12 ounces. Made by the Ready Tool Co., Bridgeport, Conn. 109

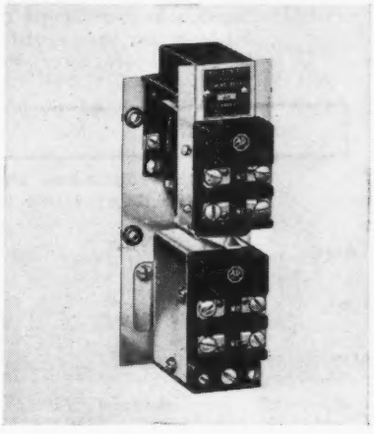


New Line of Gearmotors

Gearmotor manufactured in seventeen sizes, providing single, double, and triple reduction units having output speeds of 780 R.P.M. down to 7.5 R.P.M. Integral horsepower ratings from 1 through 75 H.P. are available for practically any industrial application. A wide selection of motor enclosures is provided, including the conventional open drip-proof, splash-proof, totally enclosed, and explosion-proof construction. Announced jointly by the Foote Bros. Gear & Machine Corporation, Chicago, Ill., and the Louis Allis Co., Milwaukee, Wis. 110

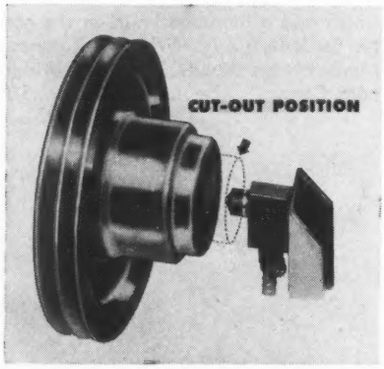
Allen-Bradley Pneumatic Timing Relay

New adjustable pneumatic timing relay announced by the Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.



To obtain additional information on equipment described on this page, see lower part of page 226.

Available for alternating or direct current. Utilizes a synthetic rubber bellows for controlling the tripping time. The range is easily adjustable from ten cycles to three minutes with an accuracy of plus or minus 10 per cent. The relay resets instantaneously and is unaffected by temperature, humidity, or vibration. 111

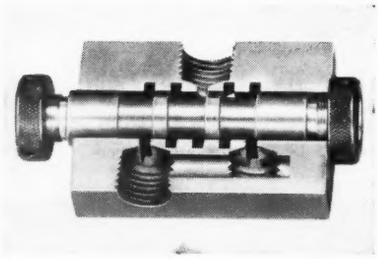


Anchor Overload Cut-Out for Motor

Improved Junior Model, Size "O" overload cut-out for all types of conveyor systems announced by Anchor Steel & Conveyor Co., 6906 Kingsley Ave., Dearborn, Mich. This cut-out serves to shut off the electric motor instantly when conveyor or machine is overloaded and resets it automatically. Will handle capacities from 20 to 150 inch-pounds. It is splash-proof and dust-tight, permitting application in atmospheres containing water, oil, or acid. 112

"Hi-Cyclic" Valve for Air-Cylinder Control

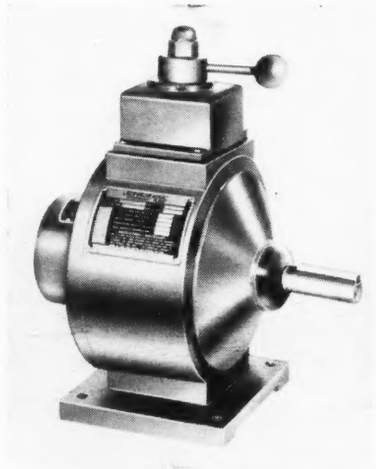
"Hi-Cyclic" air valve developed by the Beckett-Harcum Co., Wayne Road, Wilmington, Ohio, to provide accurate,

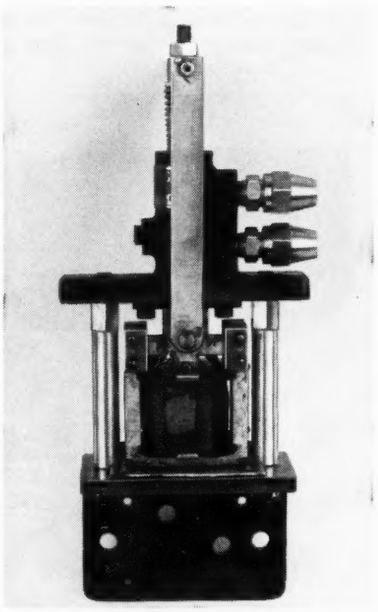


fast, and smooth control of machines or equipment operated by air power. These valves are adaptable to a wide variety of controls for automatic and semi-automatic machines. They control the length and speed of stroke of the air cylinder, as well as the pressure at both ends of the cylinder. ..113

"Superdraulic" Junior Variable-Control Pump

Junior "Superdraulic" variable-delivery pump with a capacity of 6 gallons per minute at a pressure of 5000 pounds per square inch. Adapted for use on production machines in the plastics, metal-working, and other industries, as well as in testing operations requiring pulsation-free feeds. The manual variable control permits the output to be regulated from 0 to 6 gallons per minute for control of machine operations without variation in the motor speed. Announced by the Superdraulic Corporation, 14256 Wyoming Ave., Detroit 4, Mich. 114





Hydraulic Adjustable Metering Valve

Hydraulic adjustable metering valve made by Foster Engineering Co., 4200 Woodward Ave., Royal Oak, Mich., in one, two, three or more units. The advance of the 3-inch hydraulic power cylinder piston is at the rate of 1/8 inch maximum down to 0.00001 inch per second at a pressure of 200 pounds per square inch. 115

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described in this section is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in February, 1950, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

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[This service is for those in charge of shop and engineering work in manufacturing plants.]

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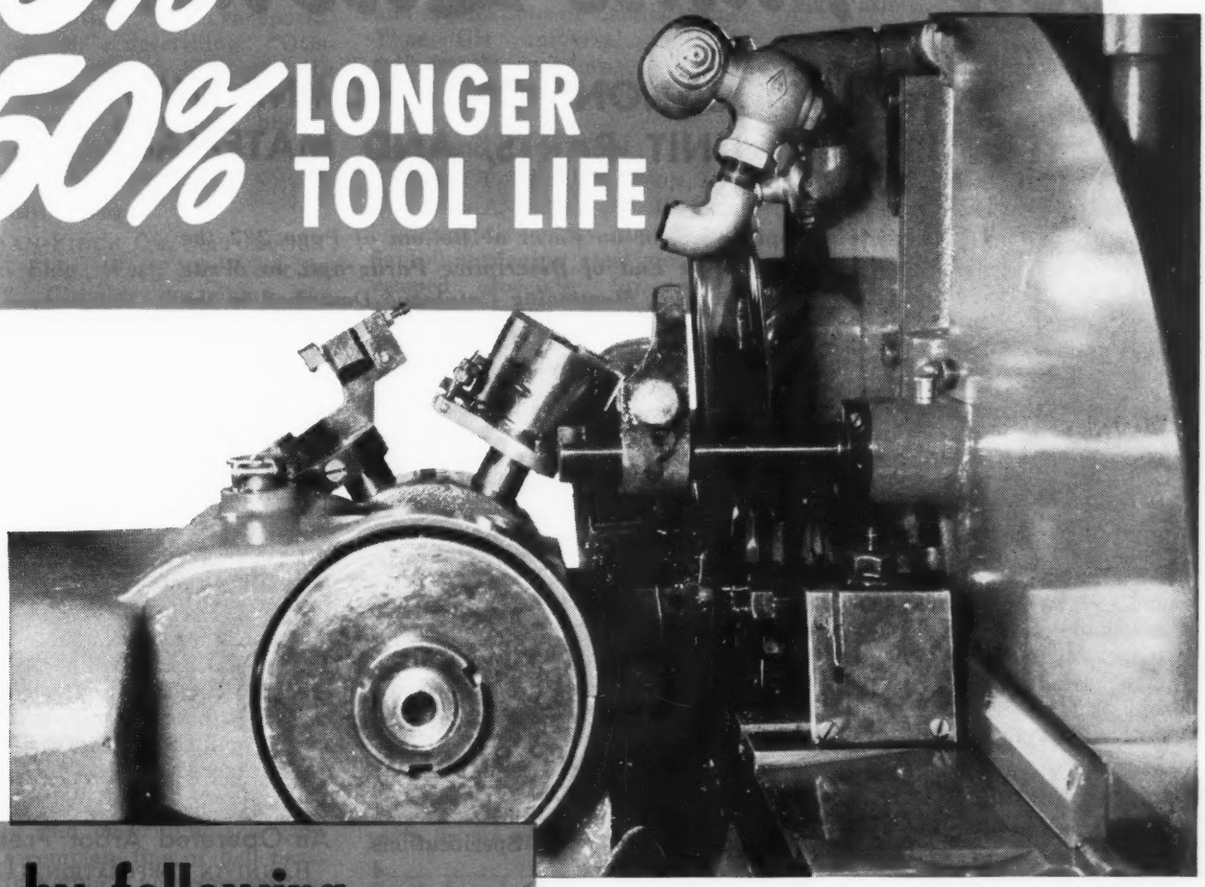
15% MORE PRODUCTION
50% LONGER TOOL LIFE



...by following the Texaco Lubrication Engineer's recommendation

A California manufacturer* machining SAE 1018 steel on Brown & Sharpe automatics, was experiencing excessive tool failures and having difficulty in getting proper finish on parts. After a thorough study of the machining operations and the condition of the cutting tools, a Texaco Lubrication Engineer recommended *Texaco Transultex Cutting Oil* to overcome the trouble.

Results of following this recommendation have been: (1) desired finish obtained, (2) increase of about 50% in tool life, (3) 15% increase in production output due to a 15-second reduction in the machine time cycle.

Whatever machining you are doing, there is a Texaco Cutting, Grinding or Soluble Oil to do it more effectively. And a Texaco Lubrication Engineer, specializing in machining operations, will gladly help you select the right coolants to help you work your metal better, faster and at lower cost.

Get these benefits in *your* plant. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

*Name on request

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New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 232 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the February, 1950, Number of MACHINERY

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METAL REMOVAL CO., 1014 N. Ashland Ave., Chicago 22, Ill. Catalogue 20, containing dimensional data and prices on carbide and abrasive production tools, including grinders, burrs, mounted wheels, abrasive bands and cartridges, etc. Copies will be sent if requested on a company letterhead, addressed directly to the Metal Removal Co.

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Clutch and Brake Unit

CLEARING MACHINE CORPORATION, 6499 W. 65th St., Chicago 38, Ill. Bulletin 213, on the Clearing "tornadyne" clutch and brake unit designed to reduce press operating costs. 34

Self-Locking Set-Screws

SET SCREW & MFG. CO., 35 Main St., Bartlett, Ill. Circular descriptive of the new Zip-Grip self-locking set-screw and adjusting screw. 35

Hydraulic Presses

AMERICAN STEEL FOUNDRIES, ELMES ENGINEERING DIVISION, Cincinnati 29, Ohio. Bulletin 1010-B, descriptive of Elmes hydraulic metal-working presses with electric control. 36

Speed Reducers

FALK CORPORATION, Milwaukee 8, Wis. Bulletin 1110, giving complete engineering data on Falk parallel-shaft sleeve-bearing speed reducers, arranged for ready reference. 37

Gear-Hobbers

HAMILTON TOOL CO., Ninth St. at Hanover, Hamilton, Ohio. Bulletin H-00-49, containing complete information on the Hamilton No. 00 gear-hobber for spur gears and pinions. 38

Magnetic Crane Control

WHITING CORPORATION, Harvey, Ill. Bulletin 72, describing the advantages of the Whiting simplified magnetic crane control system. 39

Vernier Calipers

GEORGE SCHERR CO., INC., 202 Lafayette St., New York 12, N. Y. Bulletin illustrating and describing the new Mauser vernier caliper for outside, inside, and depth measurements. 40

Worm-Gear Speed Reducers

D. O. JAMES GEAR MFG. CO., 1140 W. Monroe St., Chicago 7, Ill. Catalogue 45-S, covering the James Type S worm-gear speed reducers, including rating tables for the various types and sizes. 41

Pumps

SUPERDRAULIC CORPORATION, 14256 Wyoming Ave., Detroit 4, Mich. Circular descriptive of "Superdraulic Junior" constant- and variable-delivery pumps, with ratings from 3 1/2 to 20 H.P. .. 42

Automatic Production Presses

MINSTER MACHINE CO., Minster, Ohio. Bulletin 149, illustrating and describing typical examples of the line of Minster automatic production presses. 43

Lock-Washer Screws

PHEOLL MFG. CO., 5700 Roosevelt Road, Chicago 50, Ill. Catalogue 80-A, containing 28 pages of data on lock-washer screws known as "Sems." 44

Disk Clutches

EDGEMONT MACHINE CO., Dayton, Ohio. Bulletin SF-5, on Edgemont Type SF disk clutches, including sizes and horsepower ratings. 45

Aluminum Products

REVERE COPPER AND BRASS, INC., 230 Park Ave., New York 17, N. Y. Booklet on Revere aluminum products, including extruded shapes, drawn tube and pipe, and coiled sheet, and applications. 46

Roller Chains

CHAIN BELT CO., 1600 W. Bruce St., Milwaukee 4, Wis. Bulletin 49-2, entitled "Unusual Applications of Roller Chains," containing data of interest to machinery and drive designers. 47

Hydraulic Pumps and Controls

VICKERS, INC., 1400 Oakman Blvd., Detroit 32, Mich. Catalogue 4900, containing 47 pages of data on the Vickers line of oil hydraulic pumps and controls. 48

Power Tools

DURO METAL PRODUCTS CO., 2674 N. Kildare Ave., Chicago 39, Ill. Pamphlet descriptive of the company's line of power tools and machines, for metal- and wood-working. 49

* * *

Machine Tool Slot Cleaner

An all-steel rustproof machine tool slot cleaner is being distributed without charge by the Dayton Rogers Mfg. Co. This handy little tool is made from 0.125-inch strip steel and is approximately 8 inches long. The tool can be obtained by sending a request on a company letter-head to Dayton Rogers Mfg. Co., 2824 Thirteenth Ave. S., Minneapolis 7, Minn.

To Obtain Copies of New Trade Literature

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No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

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[This service is for those in charge of shop and engineering work in manufacturing plants.]

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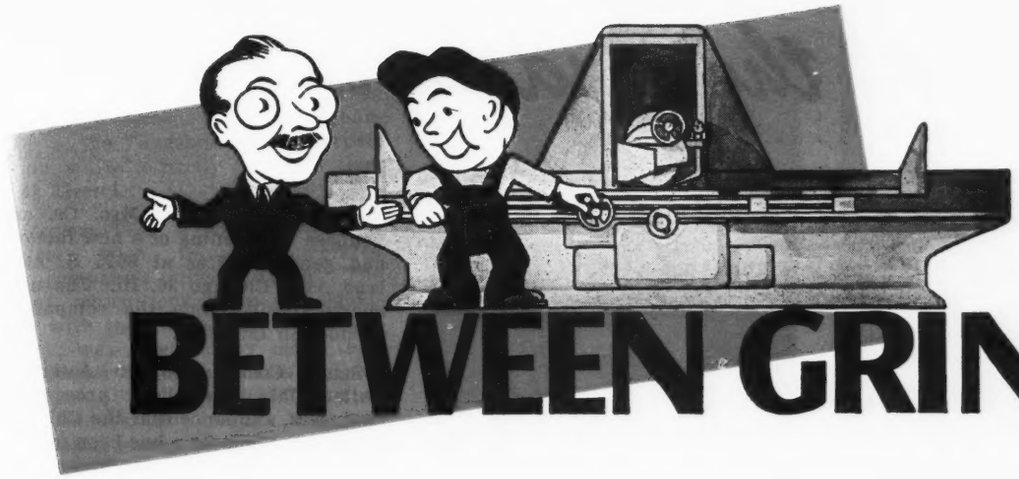
BUSINESS ADDRESS.....

CITY..... STATE.....



By E. S. Salichs

BETWEEN GRINDS

Out of Coventry

Following a review that appeared in the "Coventry Evening Telegraph" of a book on religion, said English newspaper published a number of controversial letters from its readers. A member of the Machinery Publishing Co. Ltd.'s staff (our British affiliate and, in this instance, clipping service) spotted one of the letters which contains a compliment of curious interest to us: "If a man seriously claims to be a Christian he can no more go away from his text-book, the *Bible*, than an engineer can depart from his MACHINERY'S HANDBOOK."

Unit versus United Mail

How a purchasing agent got caught up in his own red tape was an object lesson to us the other day. We received seventeen individual letters in the same mail all signed by the same man, varying somewhat in phraseology but each requesting the address of the manufacturer of one product, as described in October MACHINERY'S "Condensed Review of Some Recently Developed Materials." We consolidated our reply necessarily.

Blue Grass Compliment

A letter on our desk ended "I enjoy MACHINERY which I receive from you-all." The geographical snooper in us prompted a check on the address—Kentucky, sho 'nuf.

Machine Shop No. 5

The December issue of "Natural History" was, we understand, sent out with an odor of fragrant pine forest emanating from its pages, the secret being that the ink used in printing the magazine had been impregnated with suitable chemicals. We are cooking up an inky brew which will awaken poignant (?) remembrances as our readers turn the pages of MACHINERY, not of the forest but of days spent in machine shops before the era of air conditioning and good housekeeping. Down the sink, boss?

The Ultra in Ultrasonics

One kilowatt of power, or nearly one horsepower, can be concentrated in an area the size of a postage stamp with sound that can't be heard, according to Norman F. Barnes, General Electric engineer, who spoke before a recent meeting of the American Institute of Chemical Engineers. Going a step further in his explanation of ultrasonics, sounds pitched too high to be heard by human beings (thank you, sir), he pointed out that you can get ultrasonic energy into places where it is difficult to get other types of energy. Now we have dreamt up a Baby Barnes alarm clock—you won't be able to hear its devastating ring, but it will deliver enough ultrasonic energy for you to rise briskly.

How True (Regretfully)

"Nobody Wants to Buy Your Expenses" heads a short item in *Space*, house organ of the Hyster Co., urging economical methods of manufacture.

MOLDING HIS CAREER—Cliff Bossmann was born in Dayton, Ohio, and in his school days at Stivers High threw himself into all the mathematics, drawing, and science courses offered there, as well as attending a night school class in machine shop practice at another high school during his senior year. Upon graduation, he started as a toolmaking errand boy at the National Cash Register Co. of Dayton, at the same time enrolling in a mechanical engineering correspondence course, which he subsequently completed. His apprenticeship in toolmaking over, Mr. Bossmann was transferred to

the company's tool designing department. Some four years ago, he was promoted from designer to checker. Mr. Bossmann is now specializing in checking drawings of molds and die-casting dies, which he considers a most interesting field. His hobbies are many—he takes particular pride in his work-shop, which includes a woodworking lathe, circular saw, jig saw, drill press, and sander—and then he contributes short articles to MACHINERY (evidence of which is on page 192 of this issue), reads, snaps pictures of his little girl, and enjoys sports of all kinds. That's really filling the mold!

News of the Industry

California and Texas

JAMES A. SETCHELL has been appointed representative in San Diego, Calif., for the Allen-Bradley Co., Milwaukee, Wis., manufacturer of electric control equipment. Mr. Setchell will operate an office at 301 W. "G" St., San Diego 1, Calif., under his own name, and will have charge of Allen-Bradley sales in San Diego and Imperial Counties in California, as well as in the entire state of Arizona.

BROWN & SHARPE MFG. CO., Providence, R. I., announces the opening of a new office at 3040 E. Olympic Blvd., Los Angeles 23, Calif., with THOMAS F. MACLAREN in charge. Machine tools will be carried in stock at Los Angeles for the convenience of customers in that territory, while small tools and cutters will be sold through industrial distributors as in the past.

STUART A. WHITEHURST has been appointed Pacific Coast representative of the Selas Corporation of America, Philadelphia, Pa., consulting and manufacturing heat process engineers. Mr. Whitehurst's headquarters are at 11168 Santa Monica Blvd., Los Angeles 25, Calif.

AMERICAN BRAKE SHOE CO., 230 Park Ave., New York 17, N. Y., has opened a new sales office at 2620 Maury St., Houston, Tex., in order to provide more direct service to its customers in the Southwest territory. WILLIAM C. GEORGE has been appointed sales engineer in this territory, and will represent the company's American Manganese Steel, Electro-Alloys, and National Bearing Divisions in the new office.

Illinois and Indiana

ILLINOIS TOOL WORKS, Chicago, Ill., announces that the company has secured an exclusive license from the BOOTS AIRCRAFT NUT CORPORATION, Stamford, Conn., to manufacture and sell the company's "Tri-Lok" and "Hex-Lok" self-locking nuts. The newly acquired products will be added to the Illinois Tool Works' Shakeproof fastening line, and will be manufactured at the Elgin, Ill., plant of the company.

LEO S. OHMAN has been elected to the newly created position of vice-president in charge of manufacturing for the Hannifin Corporation, Chicago, Ill., manufacturer of hydraulic and pneumatic machinery. Mr. Ohman joined the corporation in 1948 as factory manager. He was previously connected with the Chefford Master Mfg. Co., Inc., Fairfield, Ill.

Leo S. Ohman, newly elected vice-president in charge of manufacturing for the Hannifin Corporation

J. J. ROZNER has recently been appointed works manager of the Aetna Ball & Roller Bearing Co., Chicago, Ill. Mr. Rozner joined the engineering department of the company as a draftsman twenty-one years ago, and has been chief engineer for the last ten years, a post that he will continue to hold in addition to filling his new duties.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has recently completed the construction of a large brick and steel addition to its Chicago plant. The new building provides approximately 118,000 square feet of plant and office space. It is located at 15th and Rockwell Sts.

ELMER A. TERWELL has been appointed sales engineer in the Chicago territory for Rolock, Inc., Fairfield, Conn., fabricator of heat- and corrosion-resistant alloys. His headquarters will be at 3382 Avondale Ave., Chicago 18, Ill.

W. H. SALEE has been appointed general sales manager of the Janette Mfg. Co., Chicago, Ill., builder of gear motors and rotary converters. He takes the position previously held by HARVEY KLUNDER, who recently resigned.

MID-STATES WELDER MFG. CO. announces the opening of a new factory and general offices at 6025 S. Ashland Ave., Chicago 36, Ill. The new quarters will triple the company's production facilities.

SELAS CORPORATION OF AMERICA, Philadelphia, Pa., heat processing engineers, announce that the Chicago office of the company has been moved to 3857 W. Washington Blvd., Chicago 24, Ill.

AUGUSTUS VOGEL, JR., has been appointed manager of the File Division of E. C. Atkins & Co., Indianapolis, Ind., in charge of the distribution of the company's line of files. He previously represented the Nicholson File Co.

Michigan and Minnesota

EDWARD N. COLE, formerly chief engineer of the Cadillac Motor Car Division, General Motors Corporation, Detroit, Mich., has been appointed works manager, and CHARLES F. ARNOLD, previously assistant chief engineer, becomes chief engineer. Mr. Cole succeeds CLARENCE A. RAFTREY, who died last December.

FRANK H. BISHOP has been appointed assistant to the president of the Allied Products Corporation, with headquarters at the company's executive offices, 12677 Burt Road, Detroit, Mich. Prior to his present

Frank H. Bishop, cssistant to the president of Allied Products Corporation

connection, he was employed for twenty-two years with the General Electric Co., his last position having been vice-president and general manager of the Tungsten Mining Corporation, which is partly owned by General Electric.

SNYDER TOOL & ENGINEERING CO., Detroit, Mich., recently celebrated the company's Silver Jubilee. The event, which took place coincidentally with the annual Snyder Family Party, was attended by more than 200 employes and executives and 400 members of their families. Following the banquet, HOWARD N. MAYNARD, president, presented the company's diamond twenty-five year service pins to CLARENCE SNYDER, founder and chairman of the board, and to WILLIAM VOLLMER and ALVIN ODGERS, who were the company's first employes. Mr. Snyder then presented diamond service pins to thirty-eight additional employes who had completed terms of service ranging from five to twenty years.

ALVIN J. HERZIG has been elected president of the Climax Molybdenum Co. of Michigan, Detroit, Mich., the research subsidiary of the Climax Molybdenum Co., miners and converters of molybdenum and tungsten. Mr. Herzig has spent most of his career with the company, joining the concern as chief metallurgist in 1931, at the time the research laboratory was opened. Prior to that, he had been metallurgical assistant with the National Supply Co.

JAMES C. ZEDER, chairman of the engineering board of the Chrysler Corporation, Detroit, Mich., has been elected president of the Society of Automotive Engineers for 1950.

JOHN A. SLENKER has been named manager of operations of the Duluth, Minn., district of the American Steel & Wire Co., Cleveland, Ohio, a United States Steel Corporation subsidiary, succeeding L. J. WESTHAVER, who has been made manager of operations of the Geneva Steel Co., Geneva, Utah, another United States Steel Corporation subsidiary. CLARION A. PURBAUGH will take Mr. Slenker's place as general superintendent of the Duluth Works, and KEITH H. MOODY will replace Mr. Purbaugh as division superintendent, open-hearth, at the Duluth Works.

New England

WILLIAM P. KIRK, vice-president and sales manager, machine tools, for the Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., retired from active participation in the sales program of the company on December 31. Mr. Kirk, who has been connected with Pratt & Whitney for over forty-three years, will continue to serve the company in the capacity of consulting engineer, and will also act as Pratt & Whitney representative in certain association work. ALEXANDER H. D'ARCAMBAL, vice-president and sales manager of the small tool and gage departments of the Pratt & Whitney Division, and consulting metallurgist of the Niles-Bement-Pond Co., has been appointed general sales manager of the company. In his new capacity Mr. d'Arcambal, who has been associated with the company for thirty years, will have responsibility for all the activities of the various sales departments.

(Left) William P. Kirk, retiring vice-president and sales manager, machine tools, for Pratt & Whitney Division Niles-Bement-Pond Co. (Right) Alexander H. d'Arcambal, newly appointed general sales manager of the Niles-Bement-Pond Co.

JOHN JEPPSON, assistant secretary and a director of the Norton Co., Worcester, Mass., has been appointed works manager of the company's Abrasive Division. He was formerly superintendent of the new No. 7 Norton plant, in which position he will be succeeded by JOHN R. BERGMAN, assistant superintendent. FRANK G. GIFFORD, manager of wheel plants, will expand his responsibilities to include all the manufacturing operations in plant No. 7.

ANDREW B. HOLMSTROM, vice-president of the Norton Co., Worcester, Mass., was recently elected mayor of the city of Worcester. Mr. Holm-

John Jeppson, newly appointed works manager of the Norton Co.'s Abrasive Division

Andrew B. Holmstrom, vice-president of the Norton Co., who has been elected mayor of Worcester

Photo McKeen

Arthur J. Renz, whose appointment as field engineer on precision spindle applications for the Pope Machinery Corporation, Haverhill, Mass., was recently announced

strom will serve as Worcester's first mayor under its newly adopted council-manager form of government.

GENERAL ELECTRIC CO. announces that it will expand the transformer manufacturing and testing facilities of the company at Pittsfield, Mass. The proposed expansion will more than double the present production capacity.

JOHN J. MCCARROLL, formerly connected with the Hartford office of the Brown & Sharpe Mfg. Co., Providence, R. I., is now in charge of the Rochester office of Brown & Sharpe of New York, Inc., succeeding JOHN H. BIGGS, who has been placed in charge of the Philadelphia office of the Brown & Sharpe Mfg. Co.

New York and New Jersey

KARL MACDONALD, consulting engineer of the Steam Turbine Division of the Worthington Pump & Machinery Corporation, Wellsville, N. Y., has retired after approximately forty years in the steam-turbine field. He became associated with the Worthington organization as chief engineer in 1925, having formerly held the position of engineer in charge of mechanical design with the Terry Steam Turbine Co. for about ten years.

ALBORG SUPPLY & EQUIPMENT CO. has recently been organized, with offices at 50 Church St., New York 7, N. Y., to serve as manufacturers' representative, specializing in industrial purchasing services for the railroad, oil production, refining, and marine construction fields. ALVIN A. BORGADING, previously vice-president in charge of purchases for the American Car & Foundry Co., is president of the new company.

PRECISION CASTINGS CO., INC., Syracuse, N. Y., announces that it has purchased the controlling interest in REED METAL CRAFTS, INC., of Chicago, Ill., which will expand the company's plating and painting facilities. The Precision Castings Co. has also announced its affiliation with the Wolverhampton Die Casting Co., of Wolverhampton, England, which will permit the exchange of certain outstanding developments in size and finishing processes between the two companies.

J. H. BERRYMAN has been made assistant to the manager of the Technical Sales Division of the Air Reduction Sales Co., New York 17, N. Y. He will be responsible for the technical promotion and sales of equipment for the recently introduced Aircomatic welding process.

C. A. PUTNAM, president of the Markem Machine Co., Keene, N. H., manufacturer of power-driven marking and identifying devices, has been elected president of the National Association of Manufacturers, with headquarters at 14 W. 49th St., New York 20, N. Y.

FERRACUTE MACHINE CO., Bridgeton, N. J., has appointed the following new representatives: G. W. BRUNTON & SON, 2882 Delaware Ave., Kenmore, N. Y.; and H. A. SMITH MACHINERY CO., 609 Syracuse-Kemper Bldg., Syracuse 2, N. Y.

TODD CO., Rochester, N. Y., has announced that the company has acquired the rights to manufacture and distribute the Karge Turnomat, a precision lathe and screw machine attachment for automatic turning to extremely close tolerances.

M. HERBERT EISENHART, president of the Bausch & Lomb Optical Co., Rochester, N. Y., since 1945, has been elected chairman of the board. He will be succeeded as president by JOSEPH F. TAYLOR, vice-president and treasurer.

HERBERT J. COOPER has been appointed assistant to the general manager of the Cooper Alloy Foundry Co., Hillside, N. J. He was formerly employed by the Bethlehem Steel Corporation.

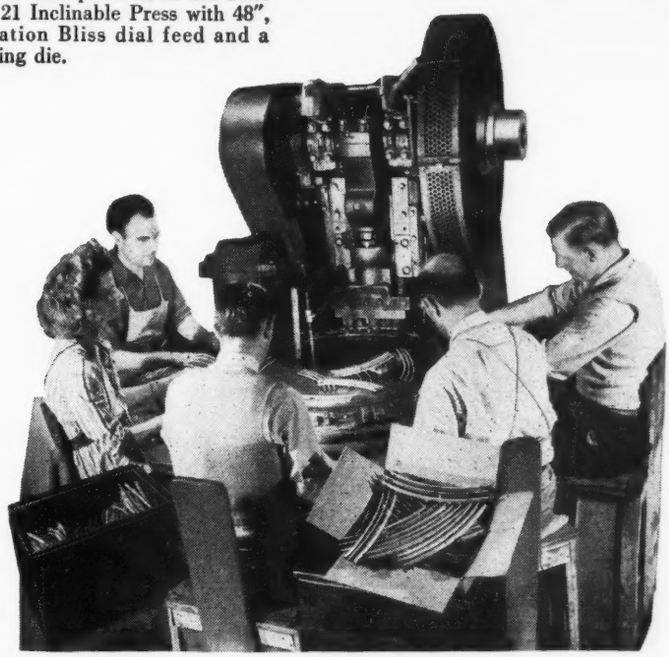
Ohio

HARVEY B. JORDAN, vice-president in charge of operations of the American Steel & Wire Co., Cleveland, Ohio (a United States Steel Corporation subsidiary), has been elected president of the company, succeeding CLIFFORD F. HOOD, who has been made president of the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., the principal steel producing subsidiary of the United States Steel Corporation. Mr. Hood takes the place of CHARLES R. COX, who recently resigned to become president of the Kennecott Copper Corporation, of New York. WALTER F. MUNFORD, who started with the company as a die-reamer thirty years ago, has been elected vice-president in charge of operations, to fill the position vacated by Mr. JORDAN. JAMES E. LOSE, vice-president in charge of operations of the Carnegie-Illinois Steel Corporation, has been elected to the newly created position of executive vice-president.

F. C. NORRIS, vice-president in charge of manufacturing and engineering of the Denison Engineering Co., Columbus, Ohio, manufacturer of industrial oil-hydraulic presses and components, has also been made general manager of the company. C. A. HUGHES, formerly plant superintend-

(Left to Right) F. C. Norris, newly appointed general manager of the Denison Engineering Co.; W. C. Denison, president of the company; and C. A. Hughes, recently named vice-president and general works manager

Rails and ties for Lionel electric toy trains are assembled at the rate of 1250 per hour in this Bliss No. 21 Inclinable Press with 48", 8-Station Bliss dial feed and a staking die.



Why Bliss Inclinable Presses Outsell All Other Makes

AND WHY IT'S THE PRESS FOR YOU

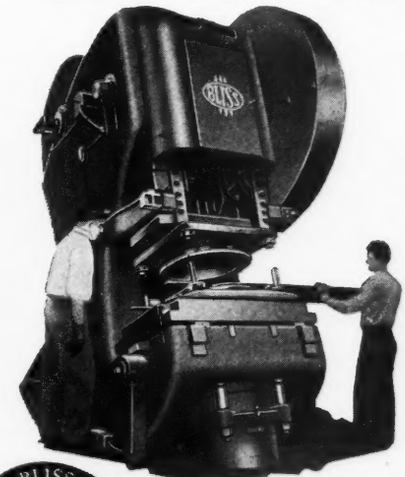
Look "inside" a Bliss inclinable press and you'll understand why it's preferred by press users everywhere...why there are more than 100,000 in use.

At the right are the reasons—plus the fact that they are priced right—most often reported to us by the trade for this overwhelming preference. They add up to ruggedness and almost indestructible precision.

If your pressed-metal production calls for inclinables, you're sure to find the answer among Bliss' wide range of standard sizes. You'll make the right choice, too, because "BLISS" on your press is more than a name...it's a guarantee!

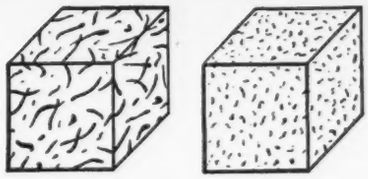
E. W. BLISS COMPANY, TOLEDO 7, OHIO

MECHANICAL AND HYDRAULIC PRESSES, ROLLING MILLS, CONTAINER MACHINERY

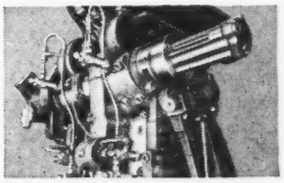


No. 30, 200-ton Enclosed Inclinable Press.

A NEW INCLINABLE PRESS CATALOG, 2-C, IS JUST OFF THE PRESS. Write for it today, as well as for Service Sheet A-105, which gives operating and maintenance instructions.

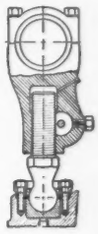


FRAME. Strong and durable press frames of high tensile Meehanite castings. Three-dimensional drawings show distribution of graphite in ordinary cast-iron (left) as compared with controlled graphite structure of Meehanite castings (right) used in Bliss presses.

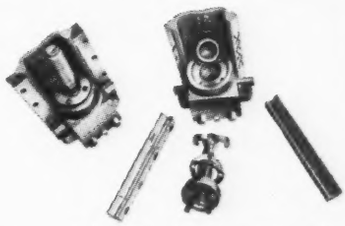


CLUTCH. Bliss patented Rolling Key Clutch, universally called the finest positive clutch available on any press. Note location of clutch keys near shaft center. This means slower-moving points of engagement, faster operating speeds, less shock during intermittent operation and longer life to all moving parts.

CONNECTIONS. Solid, plug-clamp connection strap, which gives full 360° bearing against slide adjusting screw. This arrangement also permits using V-thread on screw, making replacement easy.



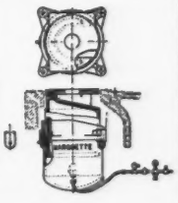
SLIDE ASSEMBLY.



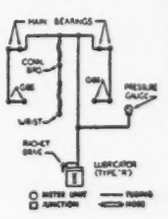
Slides are accurately gibbed to insure precise registry of die and punch. Ball seat is renewable, as are split bronze ball-cap bushings and laminated shim against which ball-cap is brought down by four bolts to give correct clearance for proper lubrication and fit.

BEARINGS, WAYS AND GIBS. Main shaft bearings and connection bearings are bronze bushed. Roller bearings are standard for drive shaft bearings on large geared presses. All wearing surfaces are especially finished to insure long life.

CUSHIONS. Every Bliss Inclinable Press is designed and machined to accommodate the Bliss Marquette die cushions which extend the press application to drawing operations.



LUBRICATION. Bliss Inclinables have floor-line lubrication systems with oil or grease fittings at main points of moving contact. All standard Bliss Inclinable frames are machined to take Bijur one-shot pressure system.



MARQUETTE · BLISS · CONSOLIDATED · TOLEDO · BLISS BUILT

Bliss Builds More Types and Sizes of Presses Than Any Other Company in the World

ent, has been named vice-president and general works manager. Mr. Norris has previously held the position of general works manager of the four Denison plants.

AMERICAN WELDING & MFG. CO., Warren, Ohio, announces the following changes in its sales department: M. R. MINNICK, formerly manager of sales, has been appointed general manager of sales. In addition, Mr. Minnick will have personal supervision of the company's Railway Equipment Division. H. D. MALONE, assistant manager of sales, has been made manager of sales of the newly created Industrial Products Division. D. W. DAWSON, previously sales promotion manager, has been named manager of the Product Development Division.

HARLAN W. BURBANK has been appointed representative in southern Ohio, the western part of West Virginia, and the state of Kentucky for the Federal Machine & Welder Co., Warren, Ohio. Mr. Burbank has represented the company for several years previously in Mexico. He will maintain an office in the First National Bank Bldg. of Cincinnati, and will operate under the name of BURBANK ASSOCIATES, INC.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has begun the construction of a new and larger steel service plant and office building on Spring Grove Ave. in Cincinnati, which will be erected at a cost of about $1,000,000. The new plant will have a total floor space of 165,000 square feet. It is expected that the plant will be completed by next fall.

JOHN H. KISHMAN has been made district manager for the Simonds Abrasive Co., Philadelphia, Pa., grinding wheel and abrasive manufacturer. His territory will include Ohio, with the exception of Toledo, and western Pennsylvania. Mr. Kishman has been sales representative for the company in southern Ohio for many years, with headquarters in Dayton.

DOUGLAS G. EATON has been appointed manager of the Cleveland, Ohio, branch office of the Reed-Prentice Corporation, Worcester, Mass., manufacturer of plastic injection molding machines, die-casting machines, and machine tools. Mr. Eaton has had many years of experience in the injection molding field.

ERNEST A. BERGLUND has been elected vice-president of the Hydraulic Equipment Co., Cleveland, Ohio. He will devote his attention to marketing and sales development. Prior to joining the Hydraulic Equipment Co., he was manager of the Hydraulics Division of the Commercial Shearing & Stamping Co.

FRANK L. CONDIT has been appointed district representative at the Chicago branch of the Berger Mfg. Division, Republic Steel Corporation, Cleveland, Ohio. He will handle the sale of lockers, shelving, and steel office equipment in the northern Illinois territory.

WILLIAM A. DELGER, formerly plant manager of the DeVilbiss Co., Toledo, Ohio, has been made vice-president in charge of manufacturing, and DON J. PEEPS, chief engineer, has been advanced to the position of vice-president in charge of engineering.

KELLY REAMER CO., Cleveland, Ohio, announces the appointment of the following sales and engineering representatives: SUPERIOR DETROIT CO., 8253 Grand River Ave., Detroit, Mich.; and ROBERT KUNTZ, 1217 E. Third St., Dayton, Ohio.

Pennsylvania and Virginia

STEPHEN M. JENKS has been elected vice-president in charge of operations of the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa., succeeding JAMES E. LOSE, who was recently elected executive vice-president of the company. The appointment of WILLIAM C. OBERG to a newly created position of general manager of operations has also been announced. Mr. Jenks was formerly general superintendent of the Gary Works, and Mr. Oberg was manager of operations for the Pittsburgh district.

JOHN MCBEIGH has joined the technical research staff of Kennametal, Inc., Latrobe, Pa., in the capacity of special development engineer. His activities will be concerned with extending the application of the new heat-resistant material Kentanium, particularly to gas turbines.

H. G. BATCHELLER, president of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa., was recently elected chairman of the board, and has been succeeded as president by E. B. CLEBORNE, executive vice-president.

WYCKOFF STEEL CO., Pittsburgh, Pa., has announced the appointment of H. L. SCHULTZ as district manager of the company's Milwaukee office. Mr. Schultz succeeds EDWIN L. WOLF, who retired December 31.

GULF OIL CORPORATION, Pittsburgh, Pa., announces the following appointments: ROY L. WHEELER has been made chief fuels and lubricants engineer of the General Machinery Section, Industrial Products Engineering Division; ROBERT A. FITCH chief fuels and lubricants engineer of the Metallurgical Section of the Division; and JOHN P. CRITCHLOW chief fuels and lubricants engineer of the Rolling Mill Section.

FAFNIR BEARING CO., New Britain, Conn., announces that it has acquired a building at 4006 York Road in Philadelphia, Pa., to expand its warehouse facilities. The new quarters also house the branch office.

JOHN W. SIMPSON has been appointed assistant engineering manager of the Atomic Power Division of the Westinghouse Electric Corporation, Pittsburgh, Pa.

STOVER LOCK NUT & MACHINERY CORPORATION, Easton, Pa., announces that it has purchased a new and larger plant at Hilton and Holly St. in Easton.

JOHN E. PAYNE has been made manager of the central district for the Westinghouse Electric Corporation, with headquarters at Pittsburgh, Pa.

RICHMOND WELDING SUPPLY CO., Richmond, Va., has been appointed a dealer for Airco gas and electric arc-welding equipment, supplies, and accessories, made by Air Reduction Sales Co., New York City.

Obituary

CHARLES OSGOOD DRAYTON, vice-president in charge of sales of the American Screw Co., Providence, R. I., died on December 19 at the age of fifty-eight years. Mr. Drayton had been connected with the company for twelve years, starting as sales manager and advancing to the position of vice-president in charge of sales in 1944. Prior to joining the American Screw Co., he had been associated with the Graton & Knight Co. of Worcester, Mass., for twenty-three years.

Mr. Drayton was born in Westboro, Mass., and attended the Massachusetts Institute of Technology and the Worcester Polytechnic Institute. He was a member of the Marketing Executive Society and a past-president of the United States Wood Screw Bureau. He had also served as secretary-treasurer of the Export Screw Association, and as chairman of the Research and Cost Survey Committee of the American Supply and Machinery Manufacturers' Association, Inc.

* * *

Both cast- and wrought-iron products were made at the Saugus Iron Works near Lynn, Mass., more than three-hundred years ago. The iron that was made at the furnace was abstracted from local ores in the blast furnace, using charcoal for fuel and clamshells and limestone for flux.

How many new ways ARE there to cut costs?

THERE IS ONE WAY TO FIND OUT IN A HURRY

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Hundreds of exhibits comprising new developments in practically every kind of equipment—machines, tools, accessories, materials handling, gages, etc., etc. The most comprehensive exposition of its kind ever held.

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ASTE

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Please mail me an advance registration form for the Industrial Cost-Cutting Exposition.

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New Books and Publications

SPANISH-ENGLISH ENGINEERS' DICTIONARY. By Louis A. Robb. 664 pages, 5 1/2 by 8 1/2 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $12.50.

The second edition of this English-Spanish dictionary, which is devoted especially to the field of engineering, has been considerably expanded. An objective in the present edition has been to cover electrical and mechanical engineering much more thoroughly, terms used in radio and television having been included. All branches of civil engineering have been brought up to date, special attention having been given to photogrammetry, soil mechanics, and airport construction, and important terms peculiar to mining and shipbuilding, oil-field operations, etc., have been included. A new feature is the notation of gender with all Spanish nouns. The dictionary is arranged in two parts, the first of which lists the Spanish words and their English equivalents, while the second gives the English words and their Spanish equivalents. Definitions are not included.

PHOTO-ELECTRICITY AND ITS APPLICATION. By V. K. Zworykin and E. G. Ramberg. 494 pages, 6 by 9 1/4 inches. Publishd by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $7.50.

The purpose of this book, which is a successor to a previous publication entitled "Photo-cells and Their Application," is to familiarize the reader with the properties, preparation, and use of photo-electric devices. It aims to present a unified study of the whole field of photo-electricity, including basic principles. methods of preparation, photo-cell circuits, and the principal applications of photo-electric devices. Emphasis throughout is on the practical aspects of the subject. Circuit diagrams, graphs, and other illustrations are used to supplement the text. Attention is given to motion picture sound, facsimile, television, and infra-red detection techniques, which are direct outgrowths of the photo-electric art.

INDUSTRIAL DIAMOND TRADE NAMES INDEX (1950). 46 pages, 5 1/2 by 8 1/2 inches. Published by the N.A.G. Press Ltd., 226 Latymer Court, Hammersmith, London W 6, England. Price, 3/6d.

This little directory containing the trade names, as well as generally used abbreviations, and the names and addresses of firms in the industrial diamond industry, was compiled jointly by the Industrial Diamond Information Bureau and the Industrial Diamond Review of England. It covers not only diamond tools, but hard abrasives, sintered carbides, and other materials for the precision engineer. A classified index is included which lists the names of products according to their specific applications, so that all the tools for a particular purpose can be readily located.

HOW TO RUN A LATHE. 128 pages, 6 by 9 inches; 350 illustrations. Published by the South Bend Lathe Works, South Bend 22, Ind. Price, paper-bound, 25 cents; fabrikoid-bound, $1.

The first edition of this lathe operator's handbook was brought out in 1914 and has been republished many times in revised and enlarged form, the present edition being the forty-ninth. Included in the material added in the new edition is data on the new International Screw Thread Form; machinability ratings and cutting speeds for various kinds of steels; standard tolerances for press, running, push, and sliding fits; allowances for finish-turning, filing, polishing, grinding, reaming, lapping, and honing; and tooling dimensions for South Bend lathes.

REPORT OF METAL TRADES COMMITTEE OF INTERNATIONAL LABOR ORGANIZATION. Distributed by the International Labor Office, Washington Branch, 1825 Jefferson Place, N.W., Washington 6, D. C. Price (set of three volumes), $3.25.

This report of the Metal Trades Committee of the International Labor Organization, presented at the third session of the committee in Geneva, Switzerland, last year, is published in three parts, the first of which is a general report on the production and other conditions in the metal trades industry throughout the world, together with information on the results of the European Recovery Program and other efforts to establish international collaboration; the second deals specifically with vocational training and promotion; and the third with wage-calculation systems.

WELDING AND CUTTING FUMES. 13 pages, 8 1/2 by 11 inches. Distributed by the Lincoln Electric Co., Cleveland 1, Ohio. Price, 25 cents.

This pamphlet contains reprints of two articles dealing with questions of health hazards in welding; including the effect of the fumes created by welding and cutting, and safeguards required for protecting eyes, skin, etc. A complete bibliography on the subject is included.

METAL CLEANING BIBLIOGRAPHICAL ABSTRACTS. Prepared by Jay C. Harris. 72 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price (paper-bound), $2.75.

Coming Events

FEBRUARY 8—Panel discussion meeting of the MACHINE DESIGN DIVISION of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Schroeder Hotel, Milwaukee, Wis. Secretary of Machine Design Division, Colin Carmichael, care of *Machine Design*, Penton Bldg., Cleveland 13, Ohio.

FEBRUARY 27-MARCH 3—Spring meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel William Penn, Pittsburgh. Pa. Executive Secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

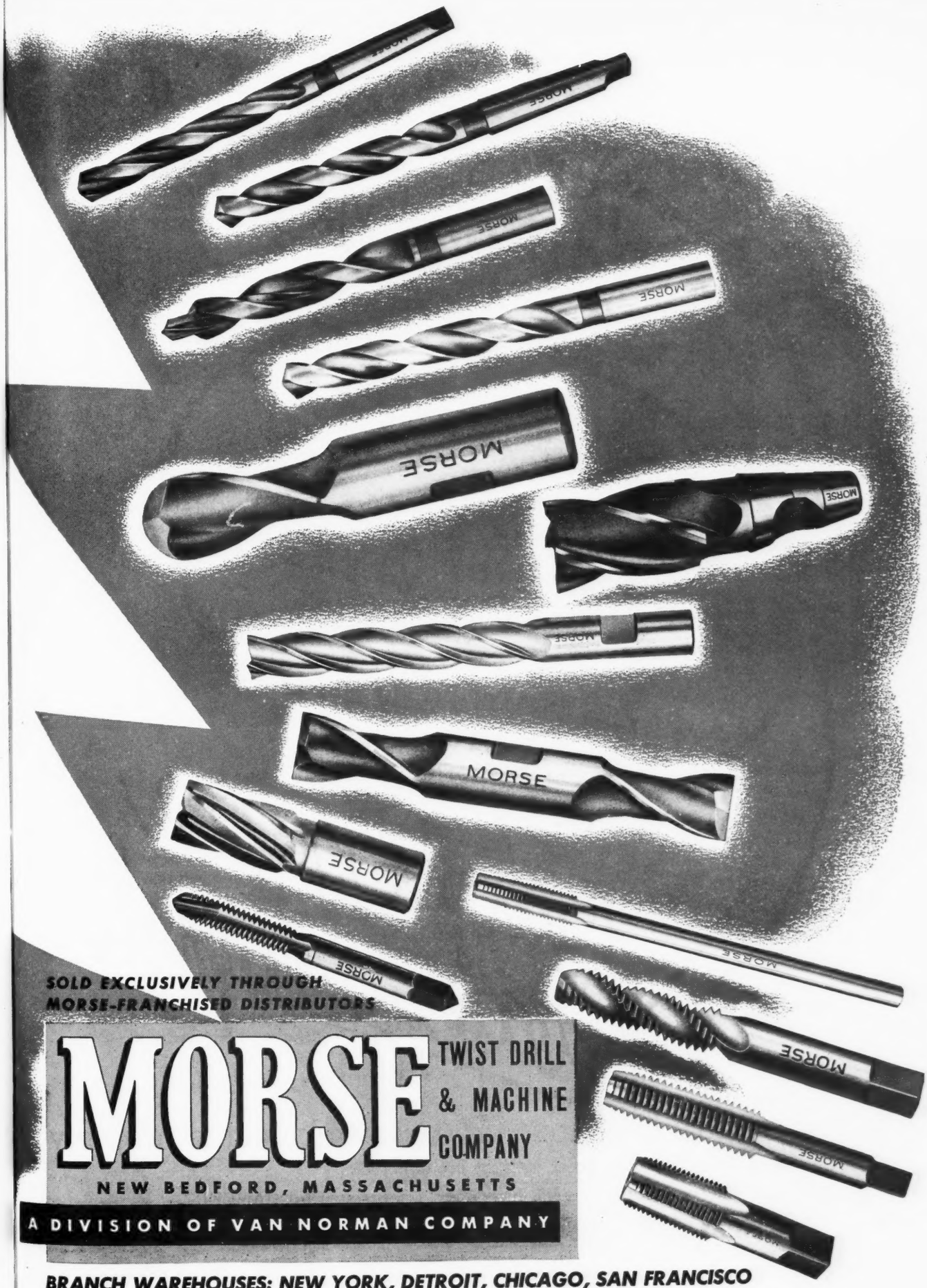
MARCH 28-31—FOURTH NATIONAL PLASTICS EXPOSITION at the Navy Pier, Chicago, Ill. Sponsored by the SOCIETY OF THE PLASTICS INDUSTRY. William T. Cruse, executive vice-president, 295 Madison Ave., New York 17, N. Y.

APRIL 4-8—NATIONAL PRODUCTION EXPOSITION at the Stevens Hotel, Chicago, Ill. Sponsored by the Chicago Technical Societies Council, Inc. Exhibit manager, John C. Toohy, 176 W. Adams St., Chicago 3, Ill.

APRIL 5-7—Twelfth annual MIDWEST POWER CONFERENCE at the Sherman Hotel, Chicago, Ill. Sponsored by the Illinois Institute of Technology, 3300 S. Federal St., Chicago 16, Ill.

APRIL 10-14—Exposition of the AMERICAN SOCIETY OF TOOL ENGINEERS at the Convention Hall and Commercial Museum in Philadelphia, Pa. Details available upon request to the Exposition headquarters of American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

JUNE 26-30—Annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS AND NINTH EXHIBIT OF TESTING APPARATUS at the Chalfonte-Haddon Hall, Atlantic City, N. J. Executive Secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.



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can be your safety signals

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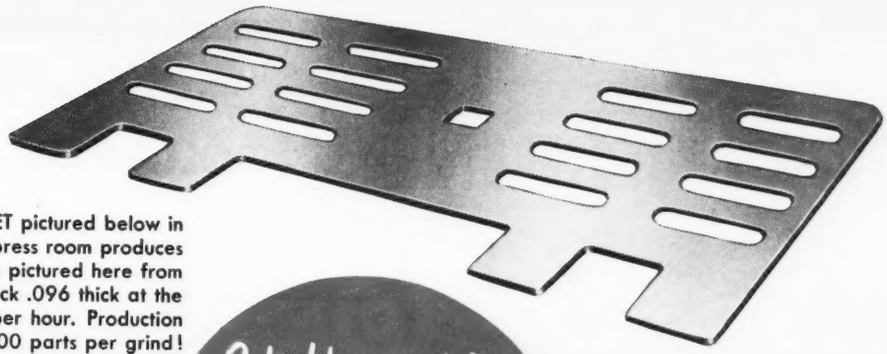

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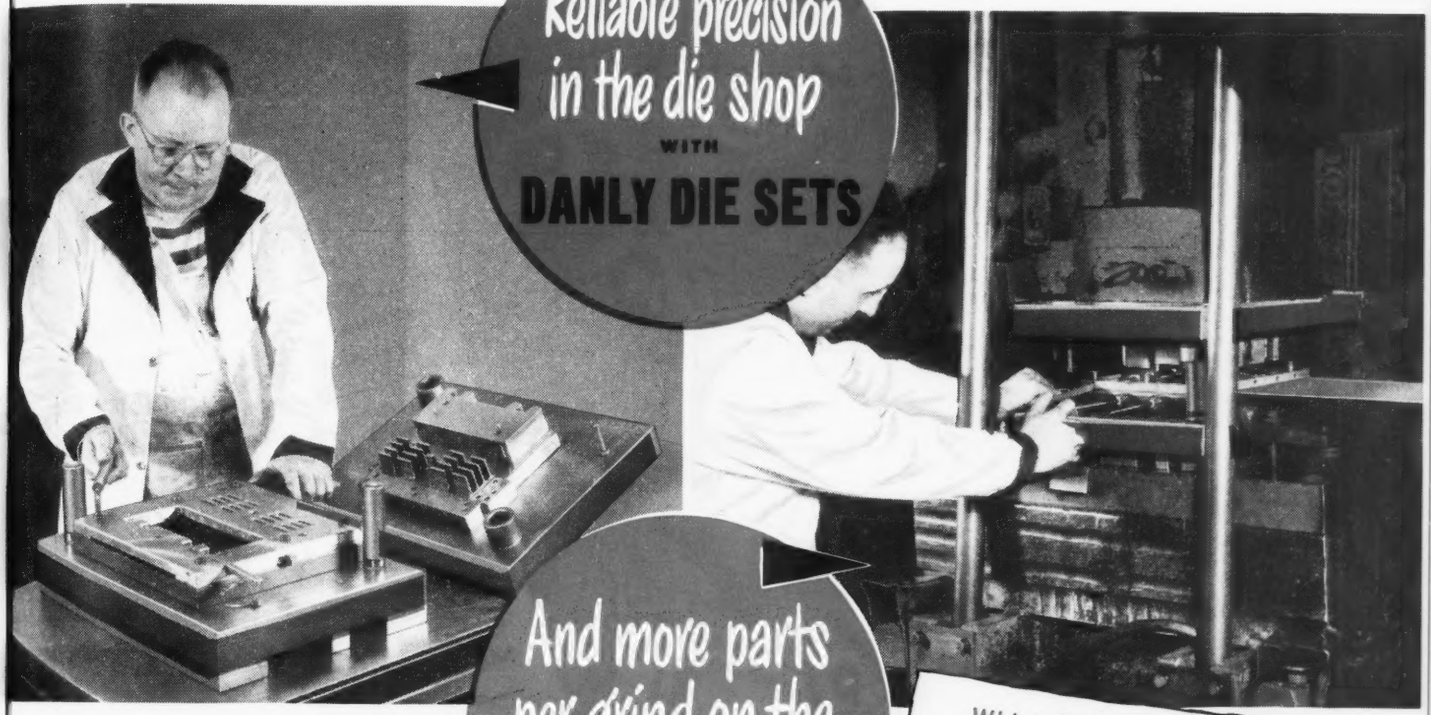

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- ★ Long Island City 1, 47-28 37th Street
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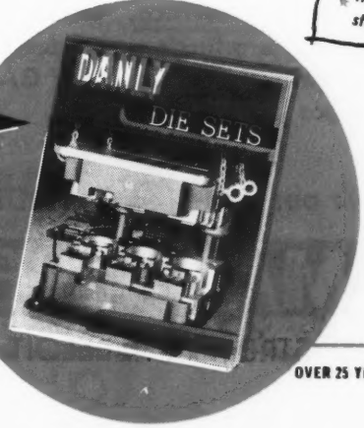

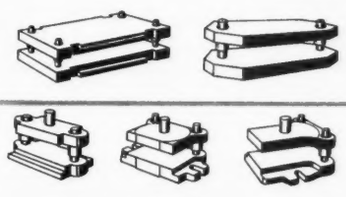

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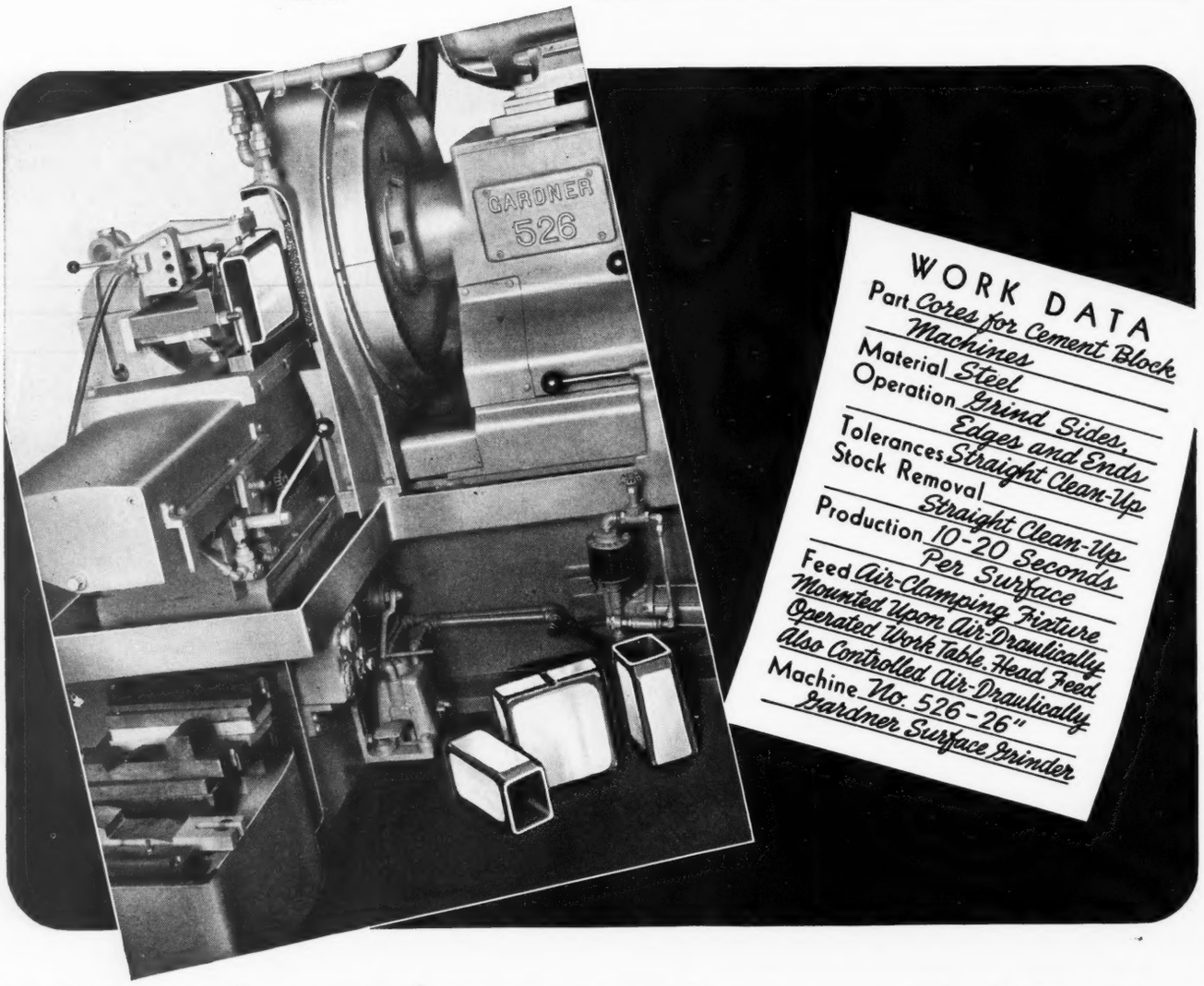
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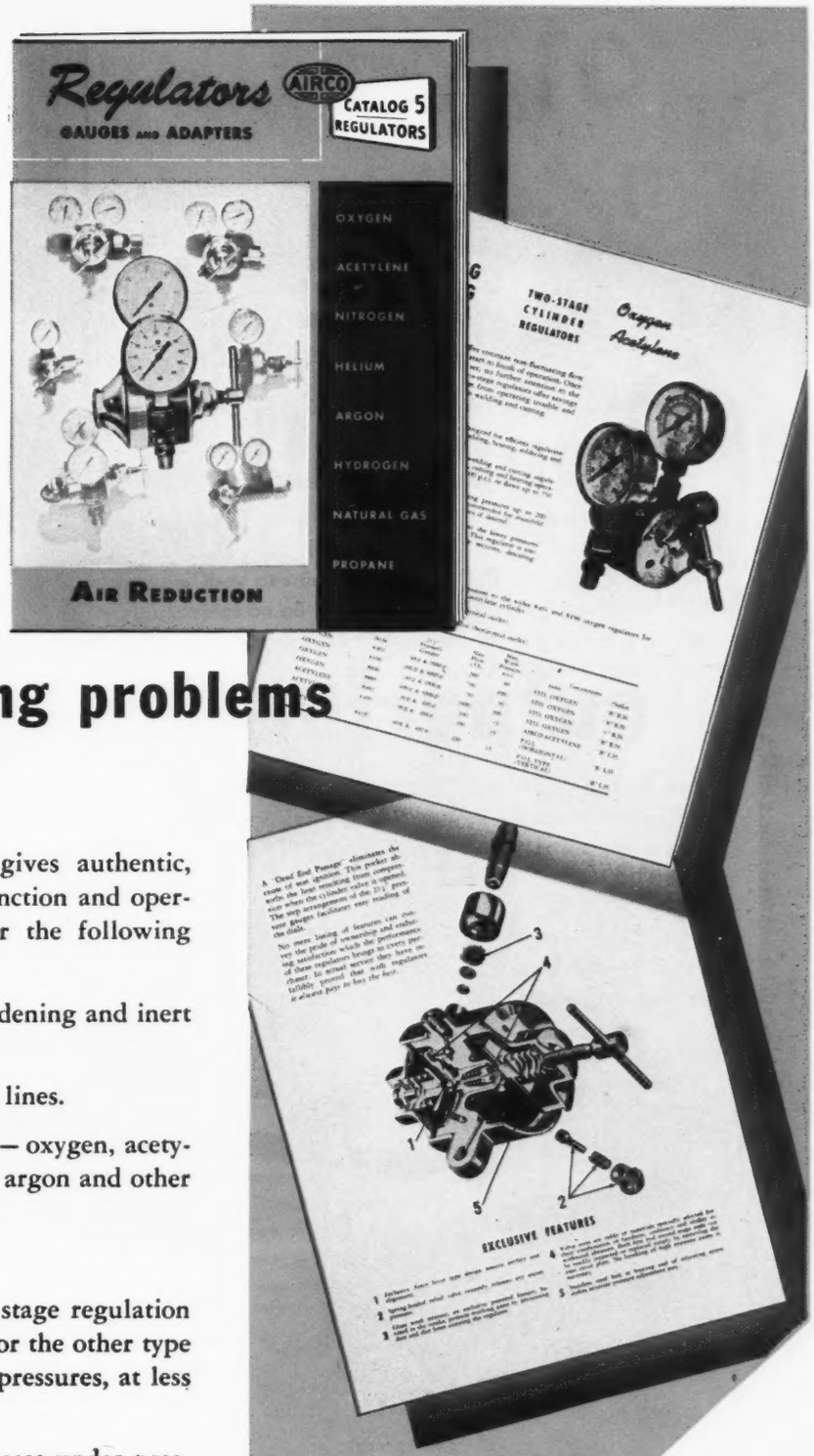

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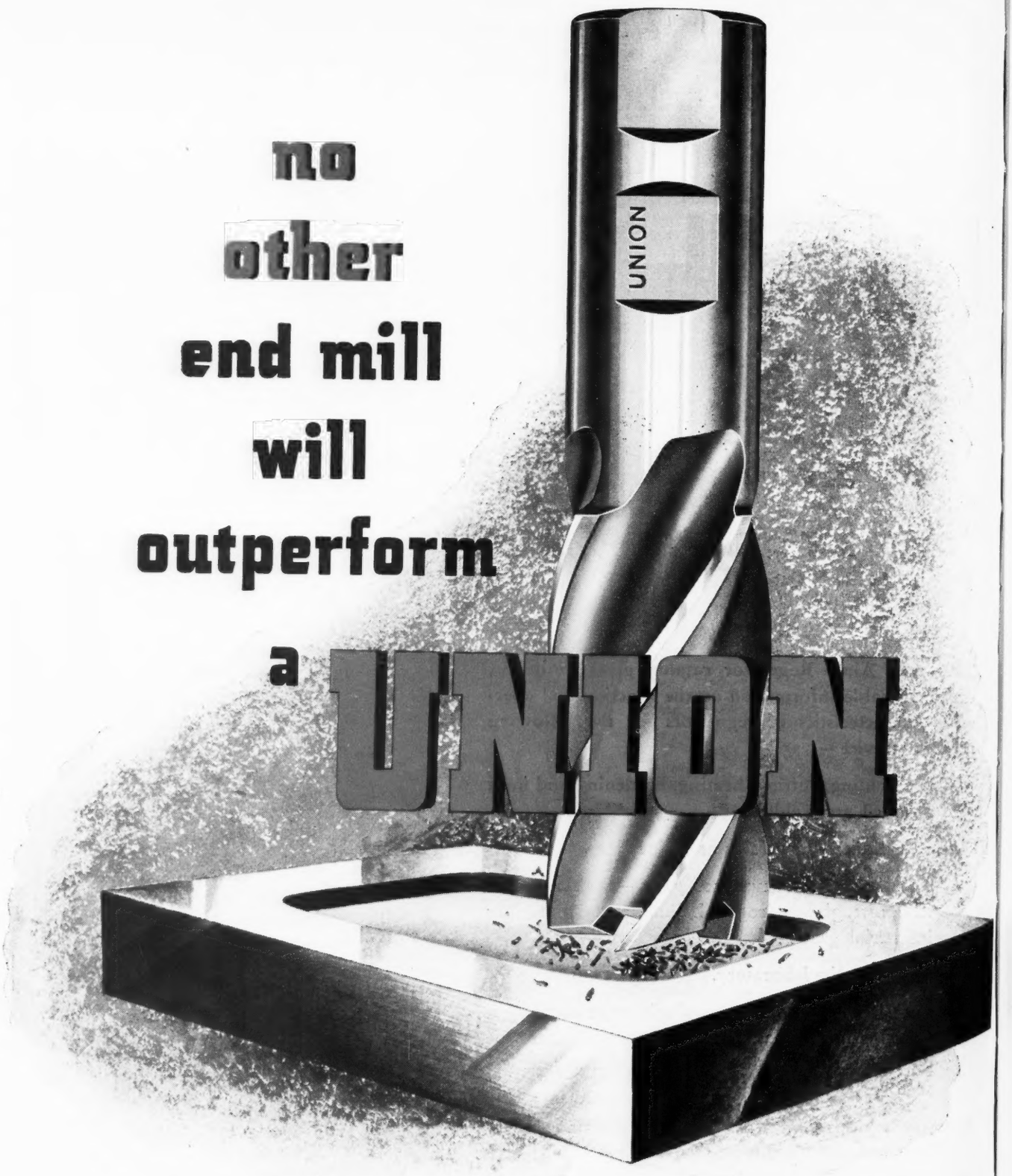

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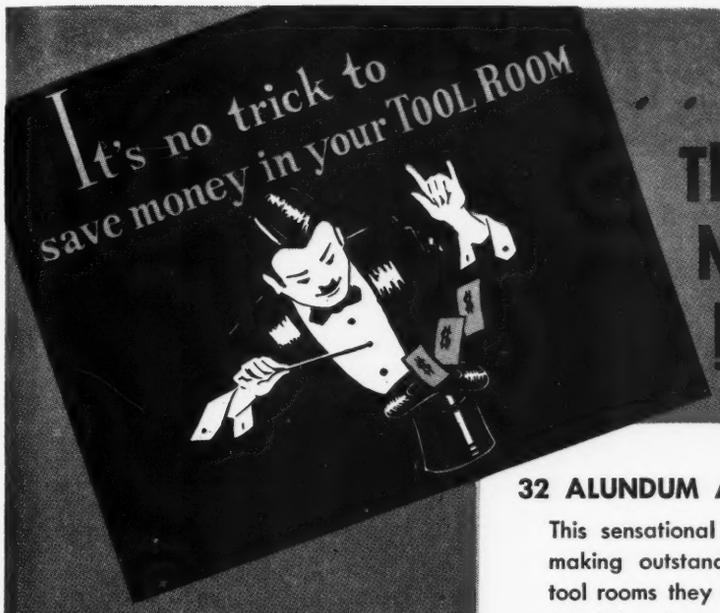

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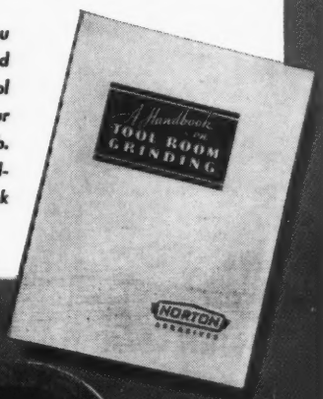

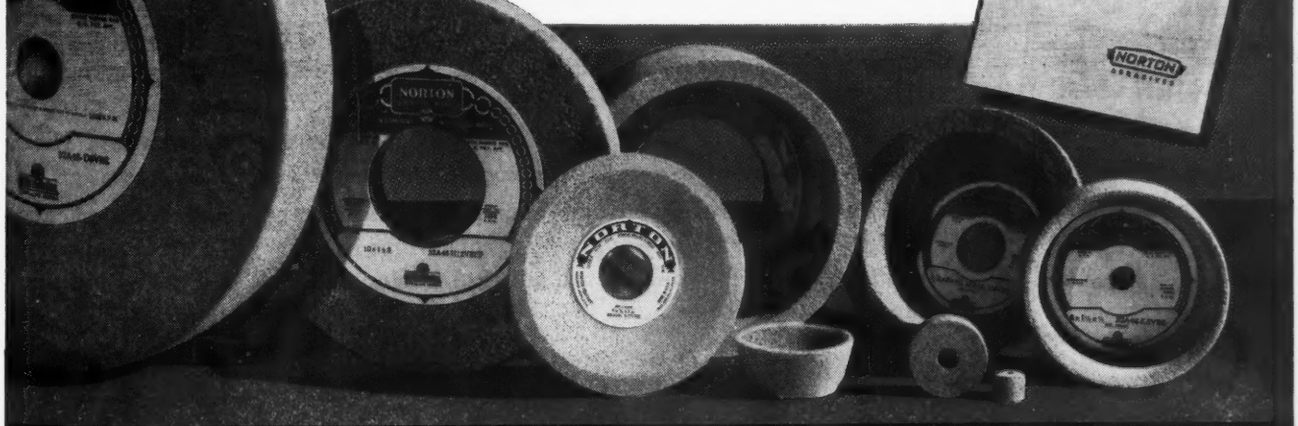

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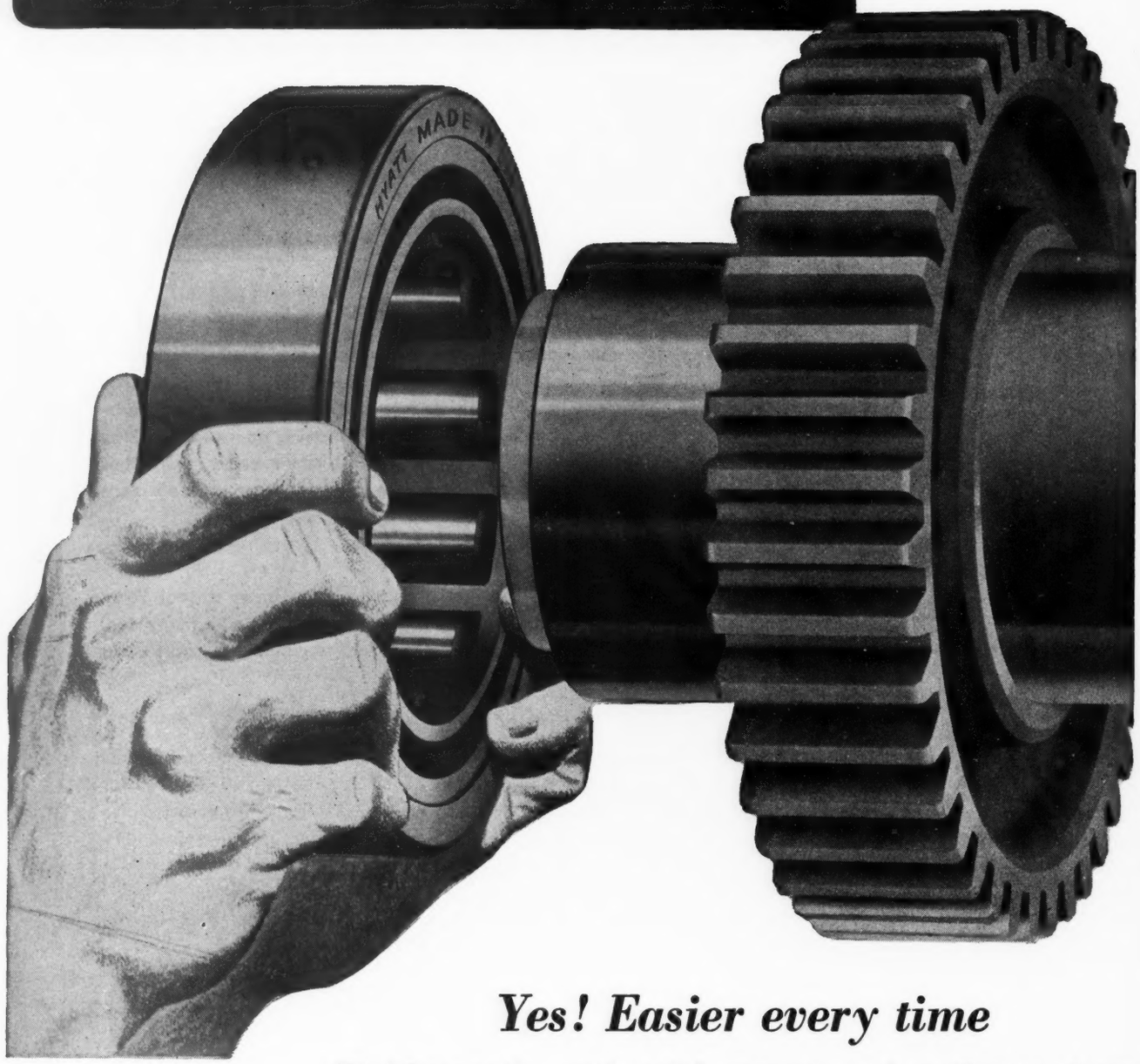

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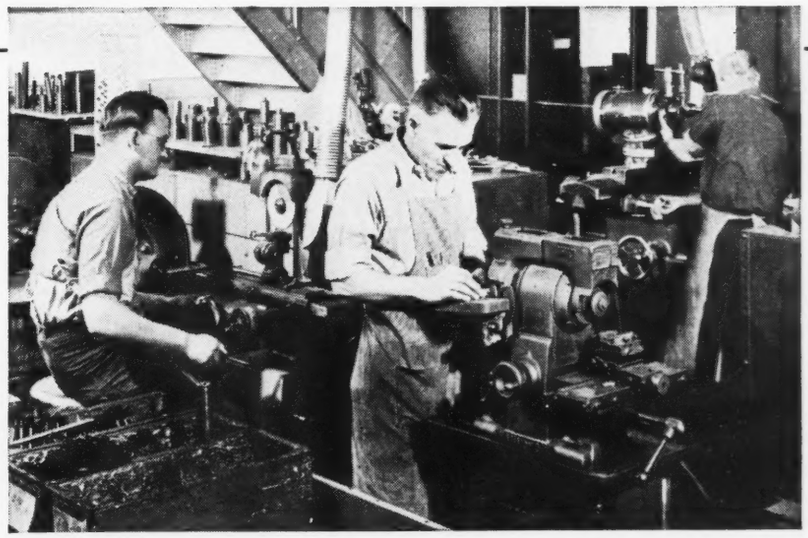

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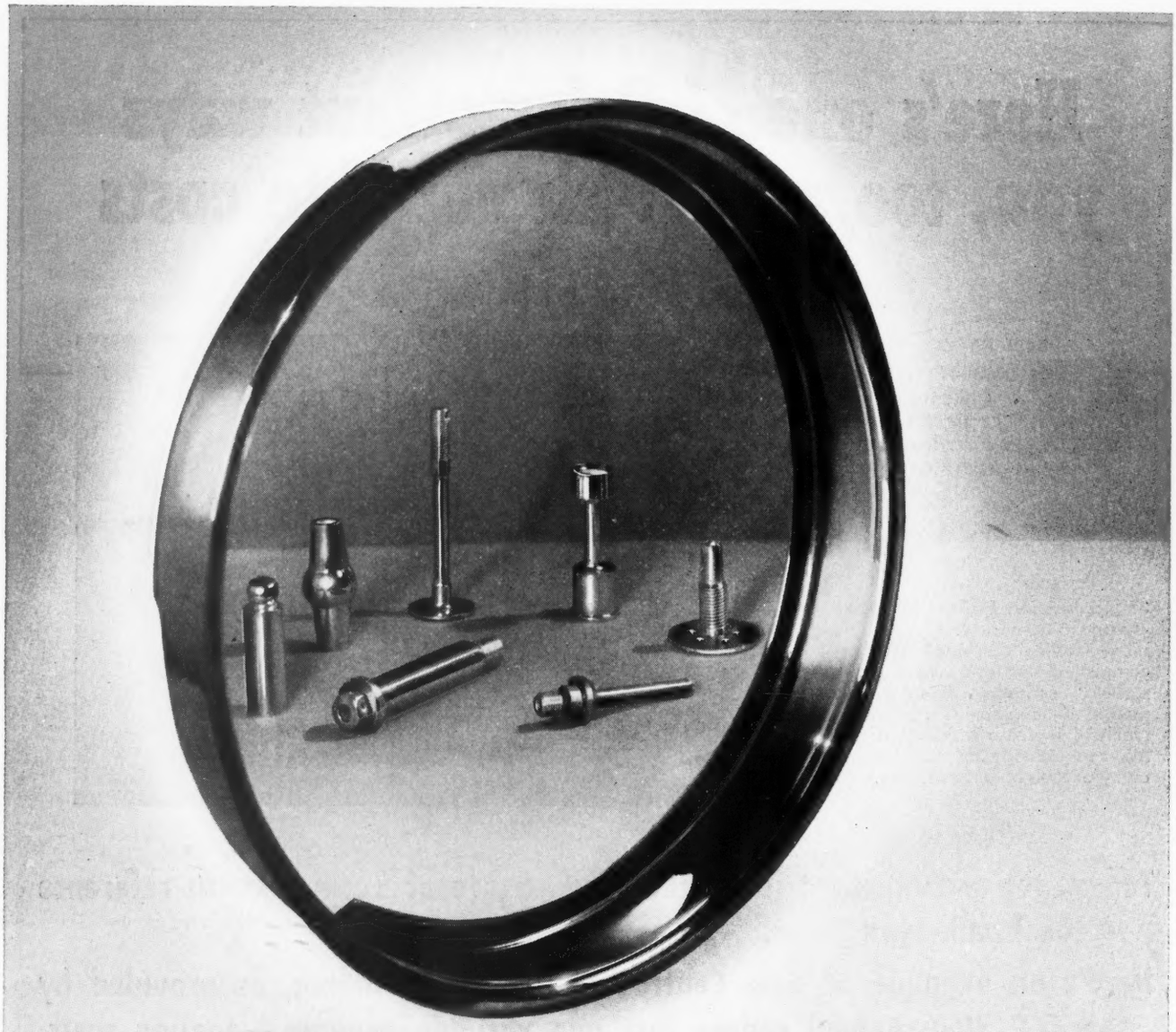

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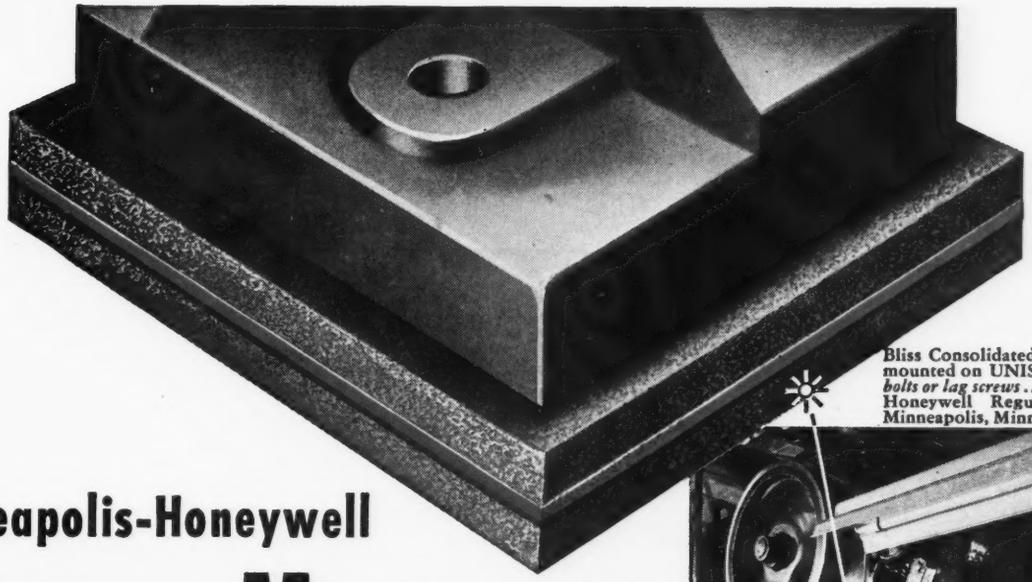

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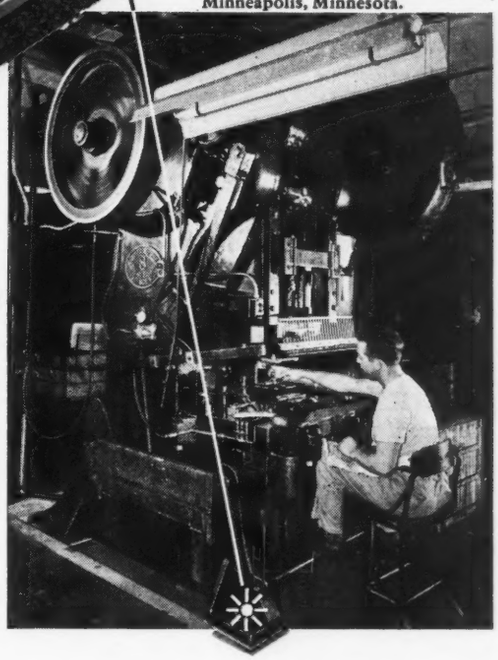

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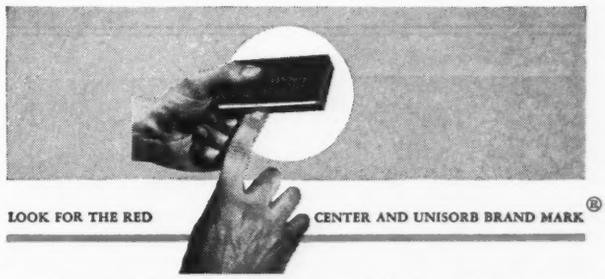

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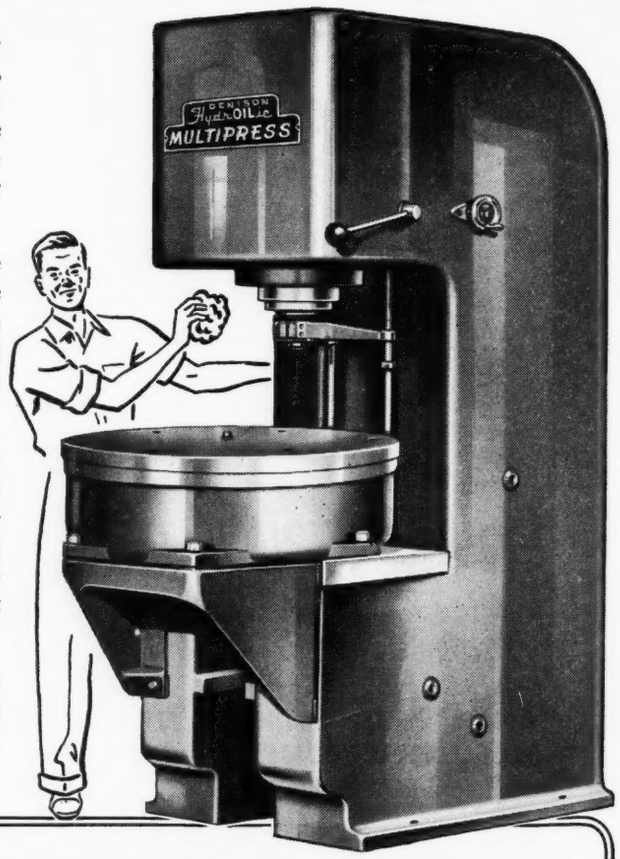
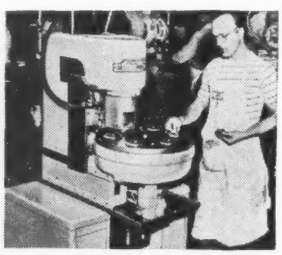
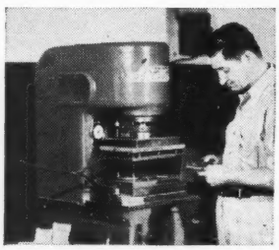
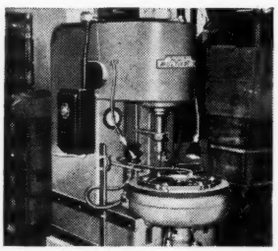




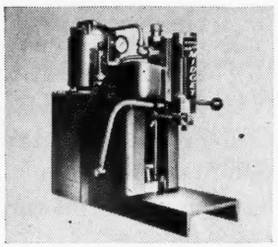
SERRATIONS are broached on small cams with this 4-ton Multipress. Parts are fed to the Multipress ram by the index table—a Multipress accessory—and pushed through cutting dies under the ram. This operator broaches 1600 cams per hour.



This 6-ton MULTIPRESS, equipped with electrically heated platens, performs a drawing operation on camera cases, and eliminates the need for presoaking the leather. Production rate is 18 to 20 cases per minute with a two-cavity die, manually operated.



Flash is trimmed from pipe plugs on this 8-ton Multipress with HydrOILic index table. On the kick press used before 6,000 blanks were trimmed in a day. Now, the Multipress operators produce 19,000 blanks a day.



The Multipress Midget—a one-ton high-speed, oil-smooth, hydraulic production tool—is ideal for small-parts work. Dual "feather touch" controls minimize fatigue, increase safety, speed production and improve quality.

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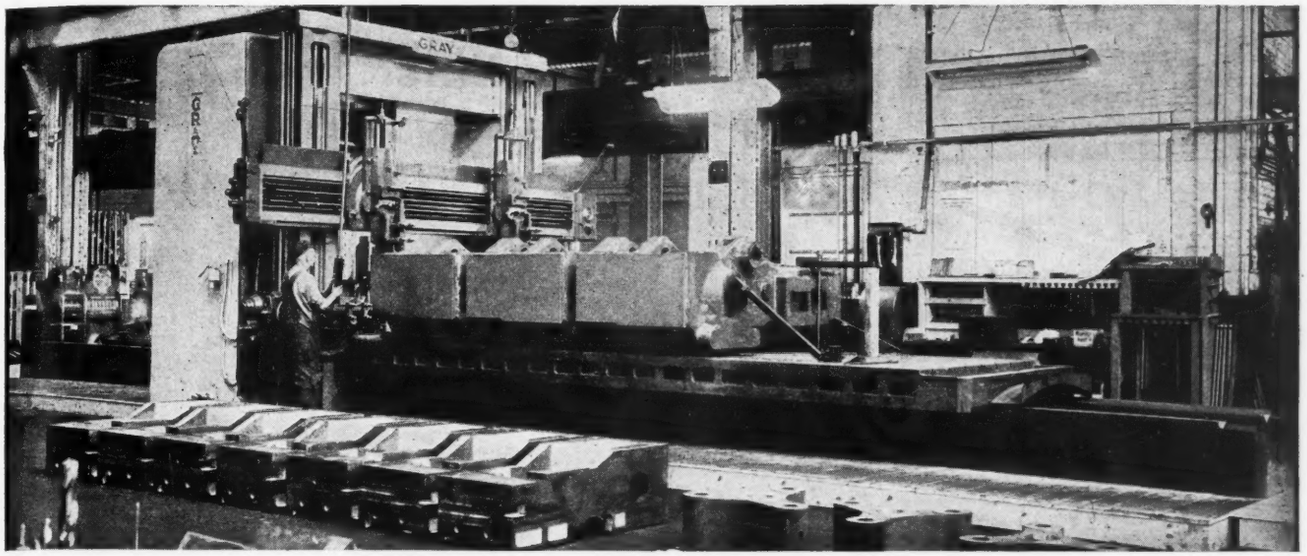
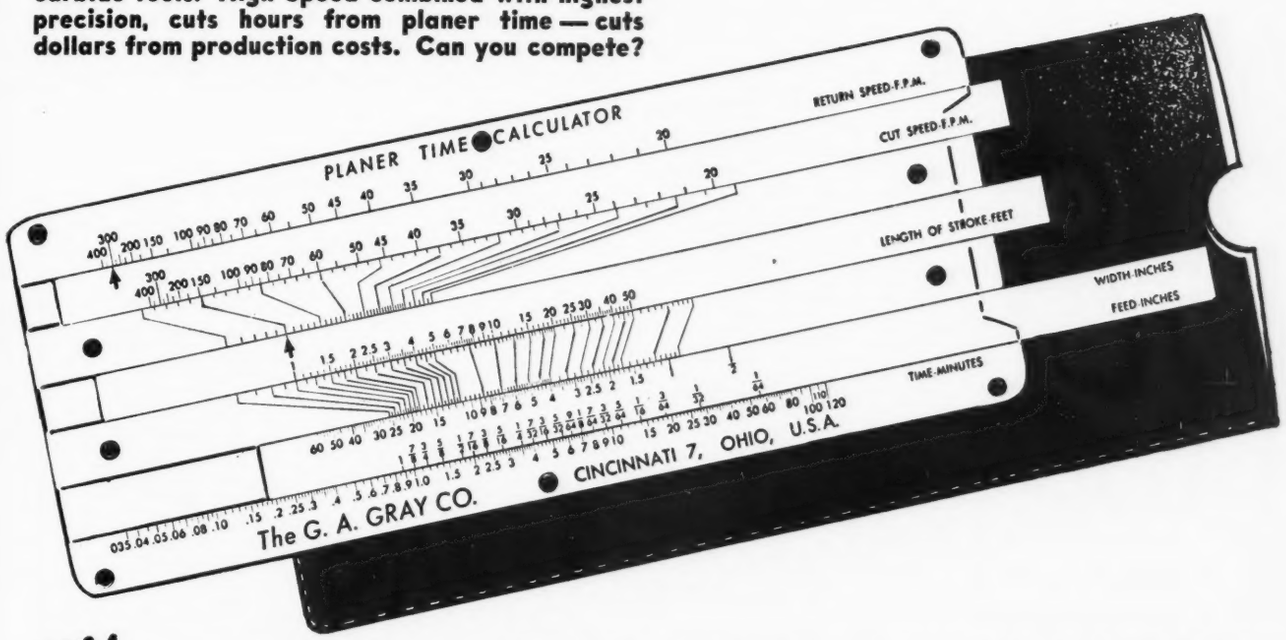


Photo courtesy Waterbury-Farrel Foundry & Machine Co.

The GRAY PLANER-

developed to effectively utilize cost-cutting carbide tools. High Speed combined with highest precision, cuts hours from planer time — cuts dollars from production costs. Can you compete?



The GRAY PLANER TIME CALCULATOR-

developed to quickly and accurately estimate machining time for modern planers equipped with high speed, variable voltage drives. The first of its kind—now available (all vinylite construction) at $2.00 each, including case.

CLIP AND MAIL TODAY

The G. A. Gray Co., Dept. AB
Cincinnati, Ohio

Please send me _____ of the new GRAY PLANER TIME CALCULATOR.
$2.00 enclosed.
Name _____
Title _____
Company _____
Address _____

The G.A. GRAY *Company*

planers • milling planers • planer type milling machine horizontal boring machines

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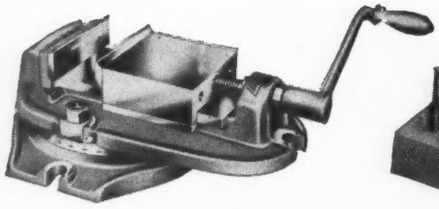
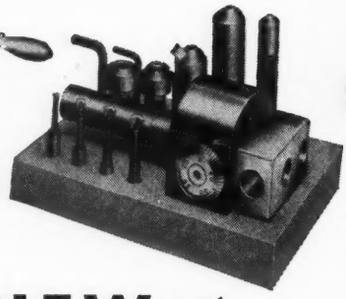
SOLD IN LATIN AMERICA BY MACHINE AFFILIATES

NEW Bridgeport ATTACHMENTS to extend the usefulness of your BRIDGEPORT TURRET MILLING MACHINES



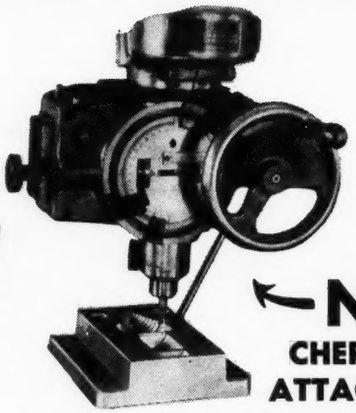
NEW MILLING MACHINE VISE

An improved, high quality vise with coolant trough. Attractively styled by "Bridgeport" to conform with the design of "Bridgeport" machines. Large diameter screw assures greater gripping power and rigid work holding without hammering crank handle.



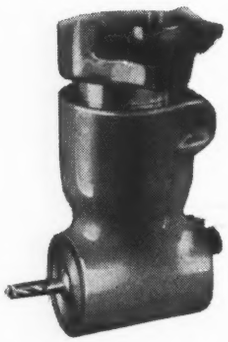
NEW No. 2 BORING HEAD

Especially designed to fit the new 1 H.P. Bridgeport Milling, Drilling and Boring attachment. It is equipped with boring tools and holder making it possible to bore holes from 0 to 6" diameter and up.



NEW CHERRYING ATTACHMENT

Designed for producing concave and convex shapes. Especially useful in producing drop forge dies, molds and cavities, metal core boxes, etc.

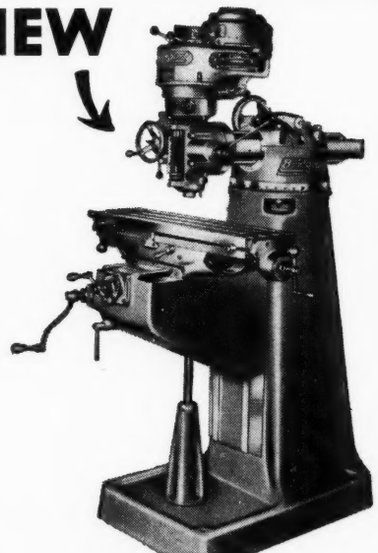


NEW HEAVY DUTY RIGHT ANGLE ATTACHMENT

For milling and drilling at right angles.

NEW LIGHT DUTY RIGHT ANGLE ATTACHMENT

Especially designed for milling and drilling narrow, deep molds and cavities.



NEW 1 HP. MILLING, DRILLING and BORING ATTACHMENT

Provides 8 spindle speeds from 80 to 2720 R.P.M. Back geared spindle drive unit utilizes full power at all speeds without belt slippage. Quill travel . . . 5".

Power feed to quill in 3 steps: .0015, .003 and .006 in. per spindle revolution.

Positive 2-way power feed stop tripping mechanism.

Spindle brake and lock for convenience in changing tools.

Collet capacity up to 3/4" diameter.

1950 starts out with several new and highly useful attachments for the Bridgeport Turret Milling Machine. In spite of the inherent versatility of this machine, these new attachments will further extend the utility of the thousands of "Bridgeports" now in everyday service, and will prove an outstanding investment for every "Bridgeport" owner.

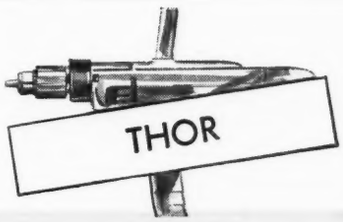
Complete details on any and all attachments available on request.

Bridgeport MACHINES, INC.

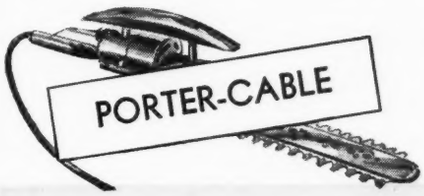
Bridgeport, Connecticut

Manufacturers of High Speed Milling Attachments and Turret Milling Machines

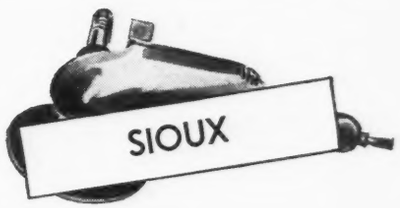
How Fafnir helps manufacturers



increase the "abuse capacity"



# of portable electric tools



Out where men are men and no refreshing coolant flows, portable electric tools show the stuff they're made of. And the job they do miles from a maintenance staff, down the tracks, out on the farm, on the building site and down in the earth proves that manufacturers put plenty of "stuff" in electric tools . . . sturdily built motors, tempered steel gears and shafts, shock-resisting housings and the best ball bearings to transmit the full power of the motor to the spindle. The fact that so many leading manufacturers of electric tools use Fafnir Ball Bearings proves how well Fafnir has worked with these manufacturers in solving their special problems.

Protection of ball bearings from contaminants has been a major Fafnir project. Some of the types most commonly used in electric tools are the felt seal, the Mechani-Seal and the Plya-Seal.

Whatever your specifications for ball bearings, Fafnir can meet them more precisely, simply because Fafnir's experience is not limited to just one or two industries but is industry-wide. The Fafnir Bearing Co., New Britain, Conn.

Fafnir Felt-Seal Ball Bearing has a cartridge type seal, consisting of two metal plates enclosing a felt washer.

Fafnir Mechani-Seal Ball Bearing has a labyrinth seal, to retain grease and lock out dirt. Outer member acts as slinger.

Fafnir Plya-Seal Ball Bearing uses a flexible synthetic washer held in place by stainless steel split retaining ring.

FAFNIR
BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

You Save more than the OIL..... when you Centrifuge FACTORY OILS

KIND OF OIL	DE LAVAL CENTRIFUGAL OIL PURIFIER removes	RESULT
CUTTING OIL	Grit Metallic Particles Water	Oil can safely be re-used indefinitely Less dermatitis Increases tool life
DRAWING OIL	Scale Metallic Particles	Saves wear on dies
GRINDING COOLANT	Abrasive Particles Metallic Particles	Saves wheel dressing time Better finishes in less time Likelihood of distorting work decreased
HONING OIL	Abrasive Particles Metallic Particles	Reduces rejects Insures mirrorlike finish
HYDRAULIC OIL BALER OIL	Condensate Solid Impurities	Eliminates rust Saves pumps and control mechanisms Valve sticking minimized Prevents hardening of leather seals
RUN-IN TEST OIL	Metallic Particles Core Sand	Tests are more reliable Oil can be re-used indefinitely with perfect safety
QUENCHING OIL	Scale and Dirt Carbon Water	Increases oil life Eliminates "soft-spots" due to moisture
SHOCK ABSORBER OIL	Metallic Particles Dirt Solid Impurities	Prevents particles causing piston wear Assures correct cushion
SLUSHING COMPOUND	Dirt Dust	Rust-preventing compound can give full measure of protection
WASHING OIL	Metallic Particles Dust Dirt	Prevents work being scored

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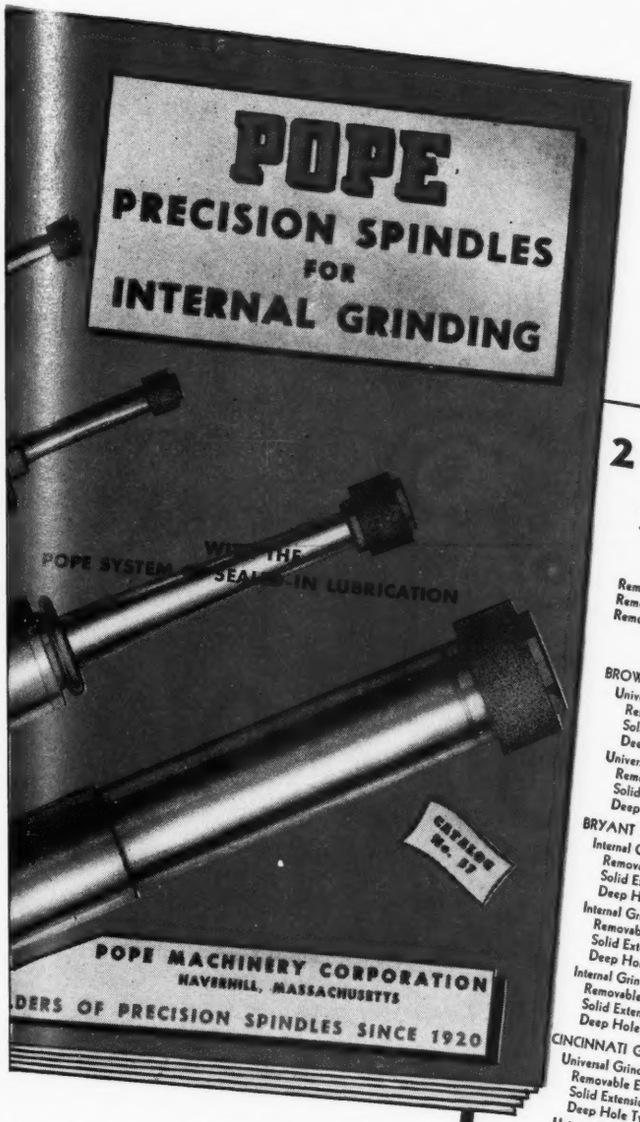
for greater operating efficiency—

DO YOU DO ANY INTERNAL GRINDING?

IF YOU DO, YOU'LL WANT THIS NEW CATALOG



2

THE INDEX

The following index is so arranged that the illustrations and dimensional data covering many Pope Precision Internal Grinding Spindles can be readily located by either the Type of Spindle (Removable Extension Arbor — Solid Extension — Deep Hole), by the Grinding Machine to which the spindle is applicable, or by Style Number.

GENERAL ARRANGEMENT OF CATALOG

Removable Extension Arbor Type Spindles . . . Pages 7 thru 20
Removable Extension Arbors (Quills) . . . Pages 21 thru 24
Removable Collet Chucks . . . Page 25
Solid Extension Type Spindles . . . Pages 26 thru 53
Deep Hole Type Spindles . . . Pages 54 thru 66
Spindle Mounting Brackets . . . Page 67

SPINDLES BY MANUFACTURER OF GRINDER

BROWN & SHARPE MFG. CO.
Universal Grinders No. 1 and 13
Removable Extension Arbor Type . . . Page 7
Solid Extension Type . . . Pages 26 and 27
Deep Hole Type . . . Page 54
Universal Grinders No. 2, 3 and 4
Removable Extension Arbor Type . . . Page 8
Solid Extension Type . . . Pages 28 and 29
Deep Hole Type . . . Page 55

BRYANT CHUCKING GRINDER CO.
Internal Grinder No. 12
Removable Extension Arbor Type . . . Page 9
Solid Extension Type . . . Pages 30 and 31
Deep Hole Type . . . Page 56
Internal Grinder No. 16
Removable Extension Arbor Type . . . Page 10
Solid Extension Type . . . Pages 32 and 33
Deep Hole Type . . . Page 57
Internal Grinder No. 112
Removable Extension Arbor Type . . . Page 11
Solid Extension Type . . . Pages 34 and 35
Deep Hole Type . . . Page 57

CINCINNATI GRINDERS, INC.
Universal Grinder No. 10
Removable Extension Arbor Type . . . Page 12
Solid Extension Type . . . Pages 36 and 37
Deep Hole Type . . . Page 58
Universal Grinders No. 12, 14, 16 and 18
Removable Extension Arbor Type . . . Page 13
Solid Extension Type . . . Pages 38 and 39
Deep Hole Type . . . Page 59

HEALD MACHINE CO.
Internal Grinders No. 70, 70A, 72, 72A, 75, 75A, 81 and 172
Removable Extension Arbor Type . . . Page 14
Solid Extension Type . . . Pages 40 and 41
Deep Hole Type . . . Page 60

LANDIS TOOL CO.
Universal Grinders No. 1, 1½, 2, 3 and 4
Removable Extension Arbor Type . . . Page 15
Solid Extension Type . . . Pages 42 and 43
Deep Hole Type . . . Page 61

NORTON COMPANY
Type "C" Multipurpose Grinder
Removable Extension Arbor Type . . . Page 16
Solid Extension Type . . . Pages 44 and 45
Deep Hole Type . . . Page 62
10 x 20 Universal Grinder
Removable Extension Arbor Type . . . Pages 17 and 18
Solid Extension Type . . . Pages 46, 47, 48 and 49
Deep Hole Type . . . Pages 63 and 64

RIVETT LATHE AND GRINDER CO.
Internal Grinder No. 1024
Removable Extension Arbor Type . . . Page 19
Solid Extension Type . . . Pages 50 and 51
Deep Hole Type . . . Page 65

General Purpose Spindles other than those listed for specific Grinding Machines are available and illustrated herein.

Removable Extension Arbor Type . . . Page 20
Solid Extension Type . . . Pages 52 and 53
Deep Hole Type . . . Page 66

INDEX BY STYLE NUMBER

Style Number	DESCRIPTION	PAGE
32-75	Spindle Mounting Bracket (for straight spindles)	67
32-75H	Spindle Mounting Bracket (for flanged spindles)	67
441-27	Tapered Shank Removable Collet Chucks (in various sizes suitable for gripping tools with shanks from 1/64 to 9/16 inches in diameter)	67
C-1001 thru C-1005	Removable Extension Arbors (Quills) 7/16 inch Series	25
P-1101 thru P-1112	Removable Extension Arbors (Quills) 5/8 inch Series	21
P-1120 thru P-1144	Removable Extension Arbors (Quills) 3/4 inch Series	21
P-1155 thru P-1183	Removable Extension Arbors (Quills) 1 inch Series	22
P-1190 thru P-1232	Removable Extension Arbors (Quills) 1 3/8 inch Series	23
P-1240 thru P-1278		24

No. 66

Look at this index page and you'll get some idea of the scope, utility and time-saving value of this new Catalog.

POPE Internal Grinding Spindles with super-precision bearings properly mounted and preloaded and having the Pope System of Sealed-in Lubrication are designed, built and dynamically balanced to increase your production and reduce your costs.

GET YOUR COPY OF THIS NEW REFERENCE BOOK MAIL THIS COUPON

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261 River Street, Haverhill, Massachusetts

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Company.....

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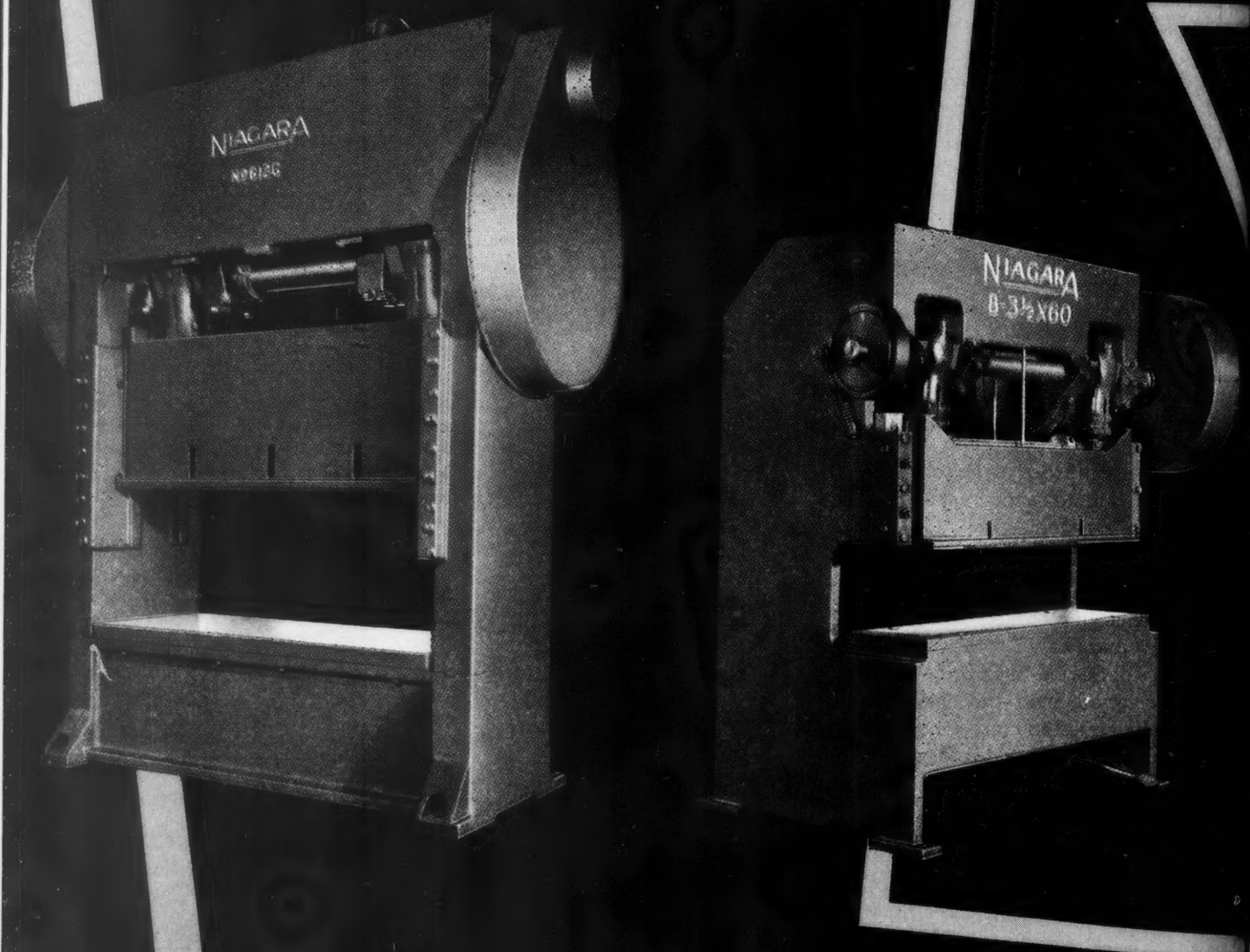
Men Responsible for P

NIAGARA AMERICA'S M

PRESSES, SHEARS, MACHINES A



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for PRODUCTION *depend on*

A'S MOST COMPLETE LINE OF

ES AND TOOLS

FOR PLATE AND SHEET METAL WORK

● Foremost manufacturers throughout industry are increasing output and cutting costs with Niagara Machines. Every man responsible for production of component parts and finished products involving shearing, blanking and forming of plate and sheet metal are finding a Niagara Shear, Press or other type of machine well suited to his requirements. Write for data on the complete range of sizes and capacities.

RKS, BUFFALO 11, NEW YORK

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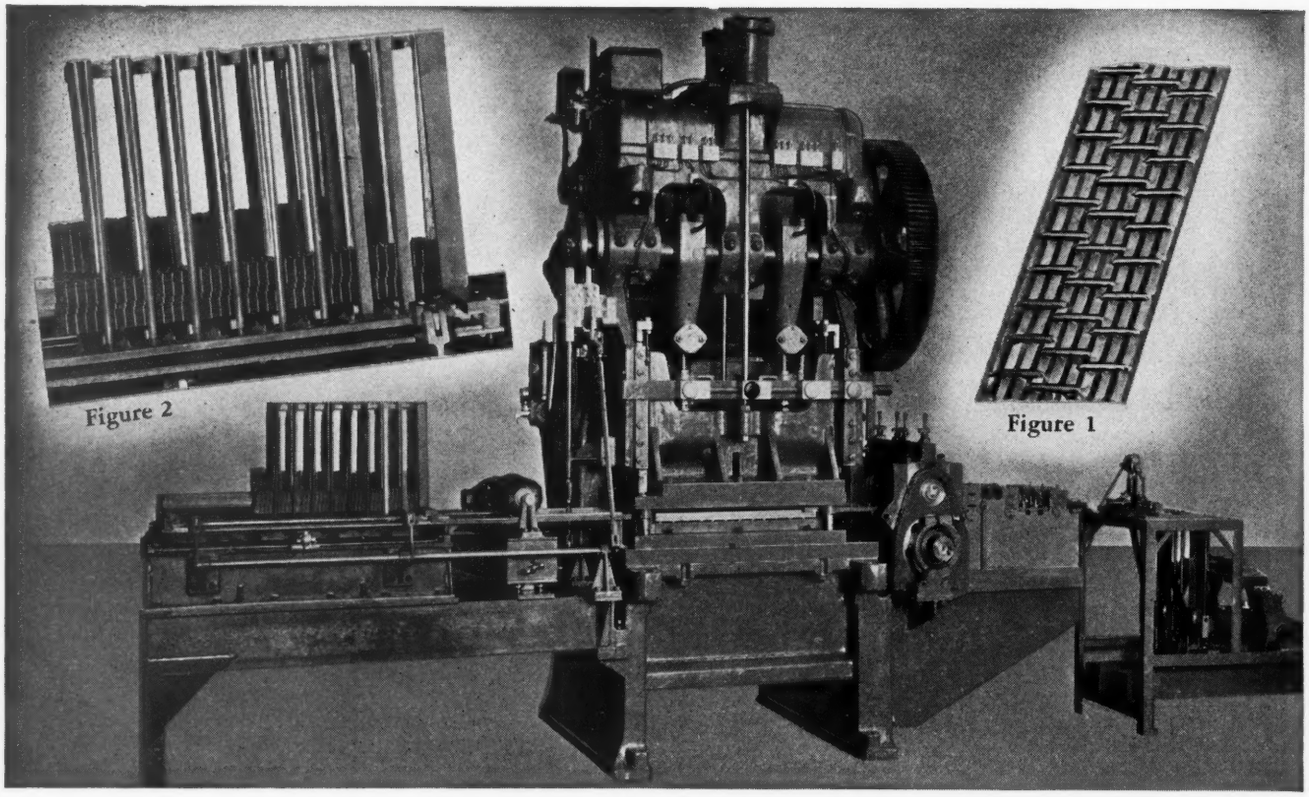

CLEVELAND press *stacks up* 120 fins a minute

120 automobile radiator fins are stacked up per minute as raw metal is uncoiled, corrugated, punched and sheared *automatically* by a leading automotive parts manufacturer using this new Cleveland Press fabricating unit.

Two strips of metal are pulled through the beading and corrugating coils by automatic coil feed. Then they are fed into the Press, which is single geared and equipped with a single station electrically controlled Cleveland Drum Type Friction Clutch. Here they are punched and sheared to length as in Figure 1. Rotating brushes pass the completed fins to the stacker where they are collected in two piles (see Figure 2).

Selecting the right press from Clevelands' wide variety of sizes and types was easy. The tough problem was how to stack the rough surfaced fins. Cleveland engineering ingenuity solved this by stacking *from the bottom* while the load is held in a raised position by a set of elevator fingers. Finished stacks can be readily removed without disturbing press operation.

If you have a production problem demanding greater press efficiency, be sure to investigate the Cleveland line. One of the many sizes and types available will undoubtedly meet your requirements. Cleveland engineers will gladly work with you on special problems. A-2716

THE CLEVELAND PUNCH & SHEAR WORKS CO. U.S.A.

Established 1880

PUNCHING TOOLS & DIES

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FABRICATING TOOLS

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• • • • • • POWER PRESSES • • • • • •

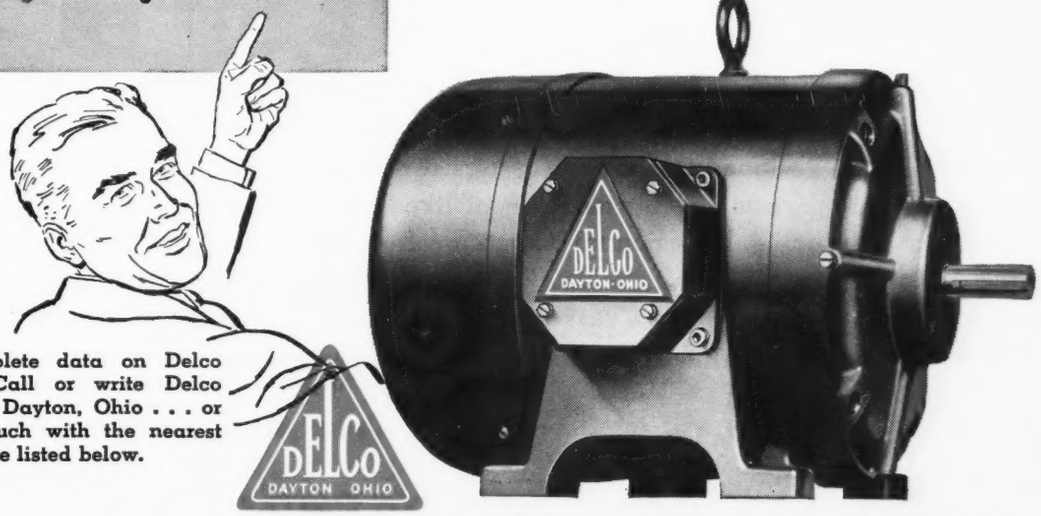
On more and more spec sheets . . .

Delco preferred!

- Positioned Bearings
- Delcote Coil Insulation
- Corrosive-Resistant Cast Iron Frame
- Positive Lubrication
- Dynamically Balanced Rotor and Shaft Assembly
- Water-Tight Conduit Box

Two words that mean top motor performance

You see the words "DELCO PREFERRED" on more and more spec sheets. That's because Delco motors are built the way production men want motors built. They are rugged, dependable, and made of the finest materials. A few of the performance extras that Delco motors give you are listed here:



Get complete data on Delco motors. Call or write Delco Products, Dayton, Ohio . . . or get in touch with the nearest sales office listed below.

DELCO DAYTON OHIO

DELCO MOTORS

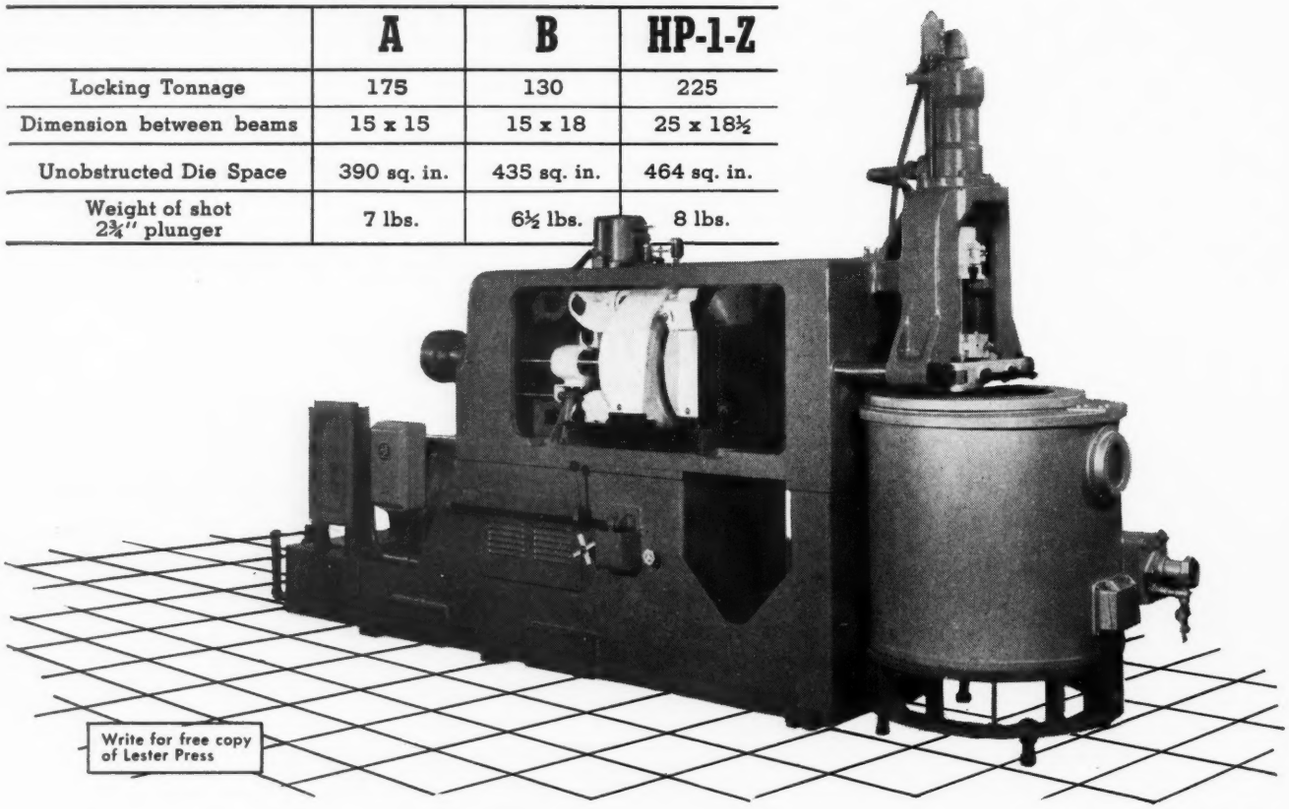
DELCO PRODUCTS, DIVISION OF GENERAL MOTORS CORPORATION, DAYTON, OHIO

SALES OFFICES: CHICAGO • CINCINNATI • CLEVELAND • DETROIT • HARTFORD, CONN.

ZINC DIE CASTING?
LESTER-PHOENIX?
YES! *and low priced too!*

COMPARE THESE BASIC SPECIFICATIONS . . .

	A	B	HP-1-Z
Locking Tonnage	175	130	225
Dimension between beams	15 x 15	15 x 18	25 x 18½
Unobstructed Die Space	390 sq. in.	435 sq. in.	464 sq. in.
Weight of shot 2¾" plunger	7 lbs.	6½ lbs.	8 lbs.



Write for free copy of Lester Press

The new HP-1-Z was designed for zinc die casters. Compare the specification—the HP-1-Z is outstanding in comparison to any machine of like size—and still retains all the famous Lester features: solid frame, large central adjusting screw, interlocking safety features, and extremely rapid production of quality pieces. • Besides all this, you get the latest development—the new, easy-to-set-up, easy-to-maintain zinc end with the big melting pot.

It's the machine designed for *your* needs—write for complete specifications.

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Abrasive Grains

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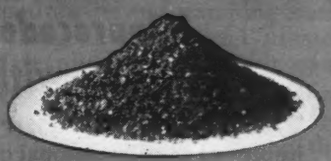
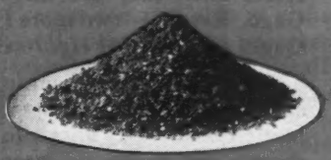
Fused crystalline aluminum oxide abrasive in all standard grain sizes, or run-of-the-mill sizes. Uniformly hard, sharp, tough. Uniformly sized—as indicated by the shadows cast by the grains pictured above.

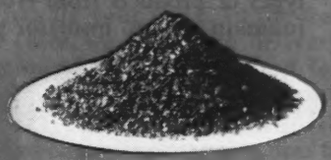
Tradenamed Borolon, Borablast, Borogrit and Sans-Slip, and produced under complete Simonds control, Borolon grain is scientifically treated to remove impurities. Let's send you inspection samples and prices. Write, specifying required grain size and intended use.



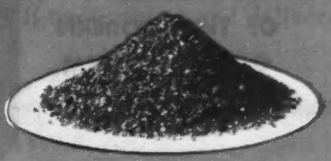
POLISHING



TUMBLING



BLASTING



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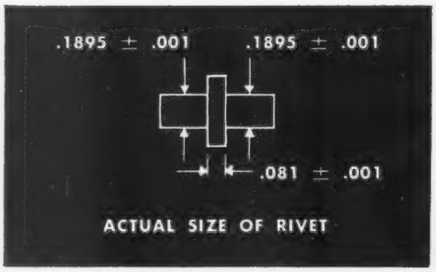

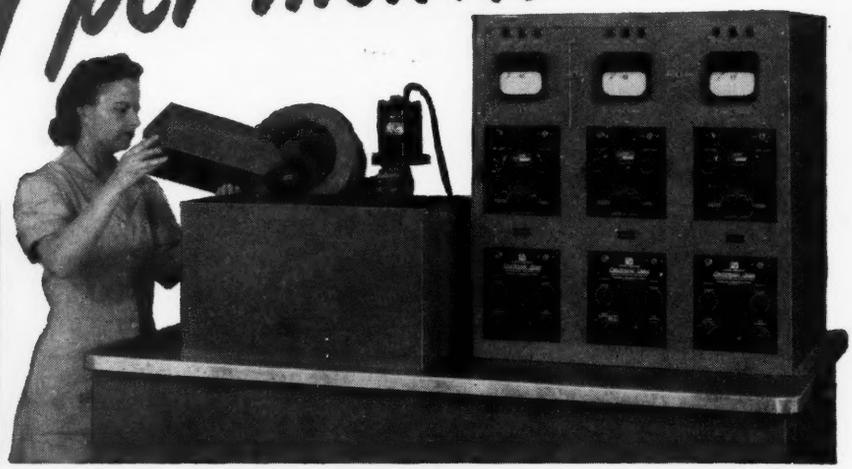

"Unprecedented savings in cost, quality, and assembly" with this Federal Electronic Sorting Gage.

That's what the owner said — This gage has improved the dimensional quality of chain rivets and has eliminated assembly problems to such a degree that the Assembly Department now refuses to accept rivets until they are inspected by this Automatic Gage. Result — two more Federal Electronic Sorting Gages are on order *right now.*

Thirty years of basic gaging know-how, plus standardized electronic components, put Federal Automatic Gages years ahead in performance. We build these gages to exactly meet your requirements. Our wide experience has served all types of industries. Automatic Gages are controlling the quality of all types of products from rivets to glass tubing, from fountain pens to insulator plates.

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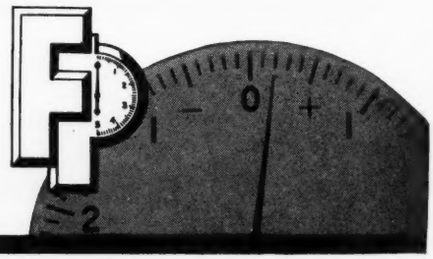
Learn how automatic and semi-automatic gages can be applied to your requirements. Write for more details—and tell us about your own problems. No obligation, of course. Federal Products Corporation, 1112 Eddy Street, Providence 1, R. I.

A FEW OF THE MANY SUCCESSFUL APPLICATIONS OF THIS MODERN GAGING SYSTEM

TYPE OF PART	DIMENSIONS	NUMBER OF SIZE GROUPS	TOLERANCE PER GROUP	PARTS PER HOUR
Disc	Thickness	2 — OK plus too thick or too thin	.0005"	3600
Movement Plate	Depth	4 — two OK plus too deep and too shallow	.002"	3600
Glass Tubing	Size	2 — Good and Bad	.005" to .040"	3600 to 4800
Piston Pin	O.D. over full length — also taper	5 — three OK groups plus over and under sizes	.000067"	3600
Fountain pen barrel	O.D. and length	5 O.D. plus over and under O.D. and length	.002"	3600

FEDERAL

Largest manufacturer devoted exclusively to designing and manufacturing *all types* of DIMENSIONAL INDICATING GAGES



Why HUNT RABBITS with a TANK?

on Most Jobs a KRW 100-TON PRESS WILL EQUAL HEAVIER, COSTLIER, EQUIPMENT

and SAVE YOU MONEY!

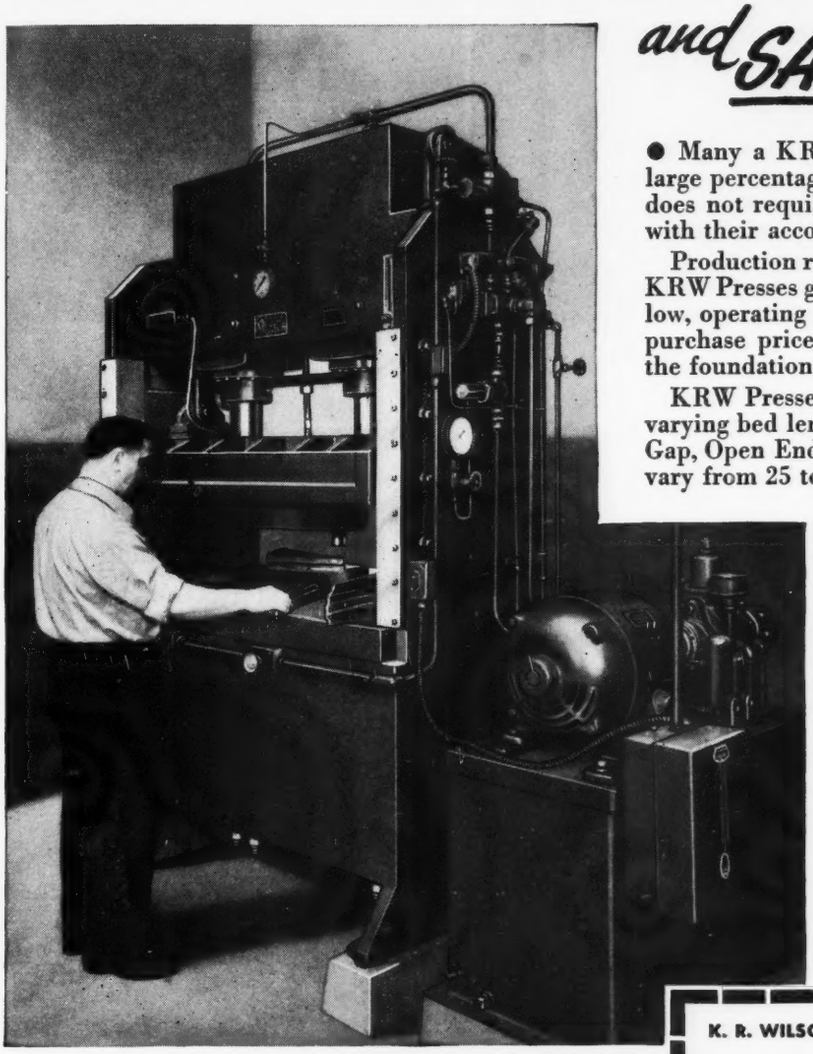


Illustration shows a KRW 100-Ton Hydraulic Press in plant of Elrae Pressed Metals, Inc., Buffalo, N. Y. When the picture was taken, bicycle parts were being formed.

● Many a KRW Press user discovered long ago that a large percentage of forming, drawing and stamping work does not require the use of large, heavy-tonnage presses with their accompanying high initial and operating cost.

Production records, in a variety of industries, show that KRW Presses greatly reduce costs. First investment is very low, operating costs are still lower. In one instance, the purchase price of a KRW Stamping Press was less than the foundation cost for heavier equipment.

KRW Presses are highly flexible...they can be built in varying bed lengths. KRW Presses are available as either Gap, Open End or Closed End Types. Tonnage pressures vary from 25 to 100 tons. Because they are hydraulically operated and not mechanically driven, they are quiet and vibrationless in operation. Platens can be stopped and reversed at any point in their travel.

Let us know your needs...we are fully equipped to engineer our equipment to handle your work. In the majority of cases, we can make delivery in a fraction of the time required for other type presses. Let us hear from you.

ALL TYPES OF DIES. We are equipped to engineer and build dies to meet your specifications. All we need is available technical data, blueprints and, where practical, a sample piece of work. We'll quote prices and delivery date.

K·R·WILSON

215 MAIN ST. · BUFFALO 3, N. Y.

K. R. WILSON, 215 Main St., Buffalo 3, N. Y.

Please send me complete information on new KRW 100-ton Hydraulic Presses.

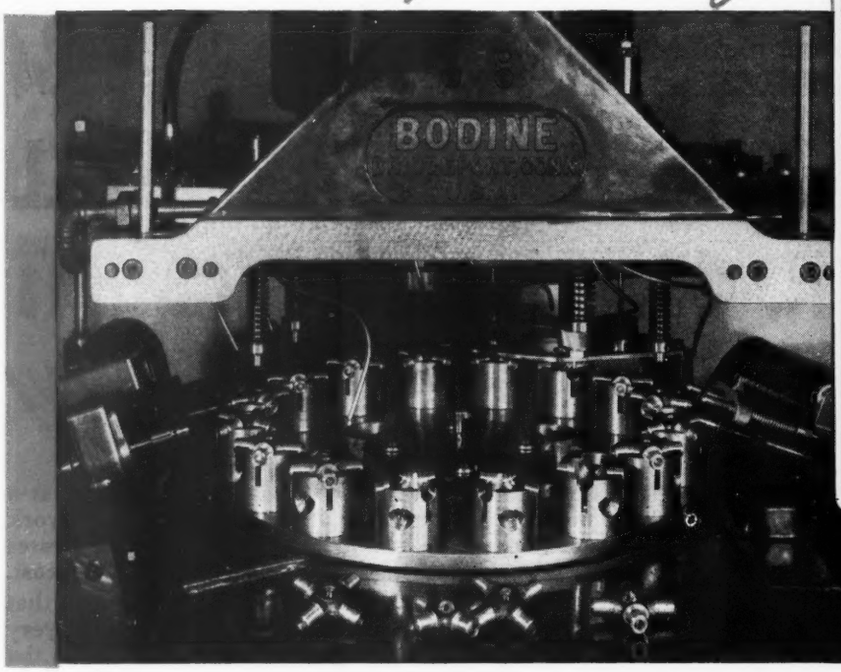
Name_____

Address_____

City and Zone_____ State_____

15

To Manufacturers of



AUTOMOTIVE *small parts*
AIRCRAFT *small parts*
ELECTRICAL *components*
RADIO *and* TV *components*
ORDNANCE *small parts*
ACCESSORIES — *instruments, relays, gages, etc.*
HARDWARE — *components or other items requiring high speed, repetitive production*

Bodine machines are so fast, so accurate and so easy to operate that their production rate outstrips that of other machinery in the average plant.

For those who can use Bodines . . . they offer a definite competitive advantage in high speed, low cost production.

Bodine engineers will gladly study your specific requirements for automatic, multiple spindle operations which may include Milling, Drilling, Tapping, Screw Inserting and assembly in one machine . . . or any combinations of the above.

Working stations are located around an automatic indexing horizontal dial. Spindles will operate from a vertical, horizontal, diagonal or inverted position. Feed and ejection are either wholly automatic or manual, depending upon the nature of the work.

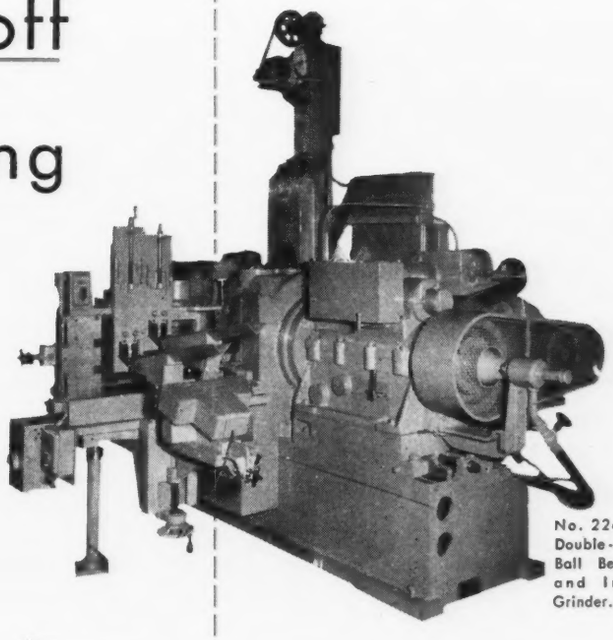
Send us your blueprints . . . or sample parts . . . for recommendations. Detailed Bulletin on request.

THE
Bodine
CORPORATION
BRIDGEPORT 5, CONNECTICUT
AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

One plant using a battery of 16 Bodines reports savings of up to *$200 per day, per machine* over former method.

in grinders . . .

your pay-off for choosing BESLY is results like these!



No. 226-30" Besly Double-Spindle Wet Ball Bearing Outer and Inner Ring Grinder.

*** RESULTS**

. . . 30 automotive valves per minute

Finish grinding of stem ends with No. 218-20" Besly Grinder. Ends are ground square with stem .002" for length—within a tolerance of .0003" locating from taper seat. 15-20 micro-inch finish is imparted. One grinder handles all valve stem sizes with a single fixture.

*** RESULTS**

. . . 24,000 ball bearing races per hour

Piece-to-piece dimension tolerances held to .0002"—with No. 226-30" Besly Double-Spindle Wet Grinder. Approximately .007" stock from outer races .218" wide and 1½" in diameter is removed. Work produced is parallel within .0001". *Maximum* capacity of the machine 30,000 ball bearing races per hour!

*** RESULTS**

. . . Up to 3000 coil springs per hour

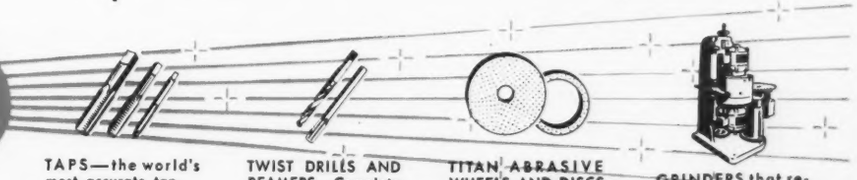
with this No. 926-42" Besly Double-Spindle Vertical Grinder. Ease and speed of loading sharply increased. Wheel dressing greatly simplified. Change from one spring size to another quickly made.

**All names furnished upon request.*

Just as they have done in the case studies reported here, the chances are Besly Grinders can help you to lower-cost production and improved quality of output. *In scores of other companies they have achieved similar results.* So, call in the Besly engineer. Let him show you whether your grinding operations can be made more efficient. In addition, it is very likely that he can point out new applications in which a change-over to grinding can substantially reduce your processing costs. Such a survey costs you nothing—but the experience of the Besly engineer and engineering organization can be invaluable to you. Write us today.

BESLY

CHARLES H. BESLY & COMPANY



TAPS—the world's most accurate tap.

TWIST DRILLS AND REAMERS—Complete line for every need.

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GRINDERS that reduce costs on every type of surface grinding.

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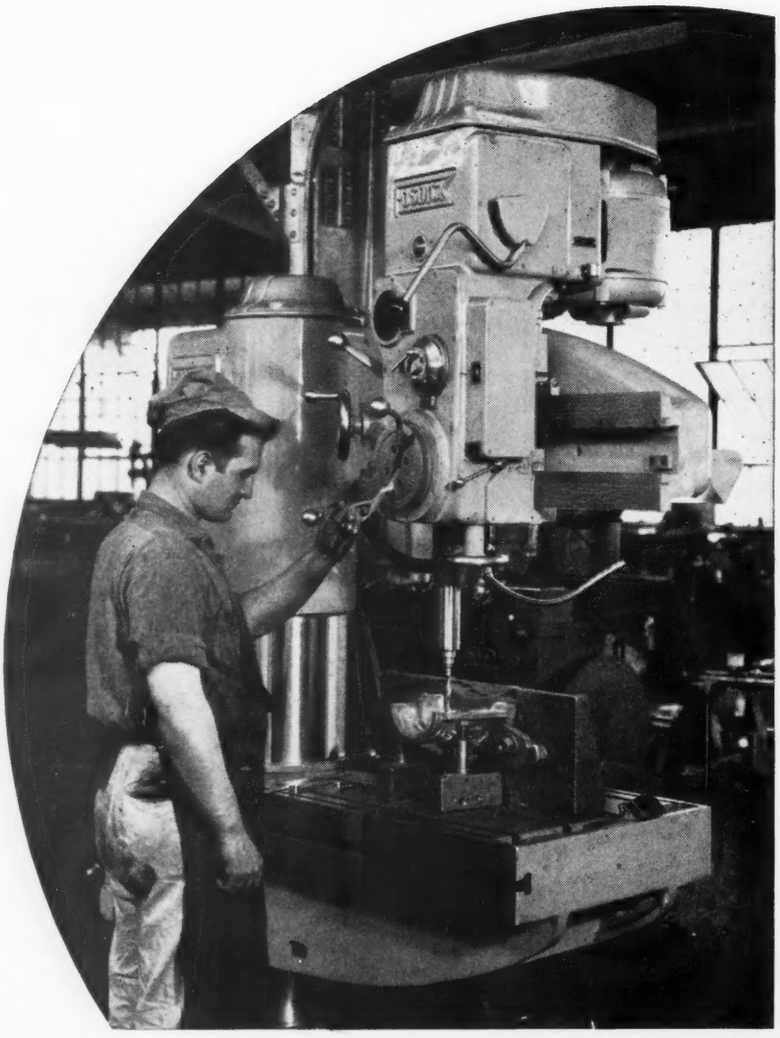


For PRODUCTION
For MACHINE SHOPS
For TOOL ROOMS

FOSDICK *Sensitive* RADIAL

• Wherever there's a need for holes up to 1½" diameter it will be to your advantage to investigate this exceptionally versatile machine.

The sturdy construction of the Fosdick Sensitive Radial from base to arm — the rigid one piece column — the heavy adjustable table — and the massive arm all contribute to accurate, dependable production.

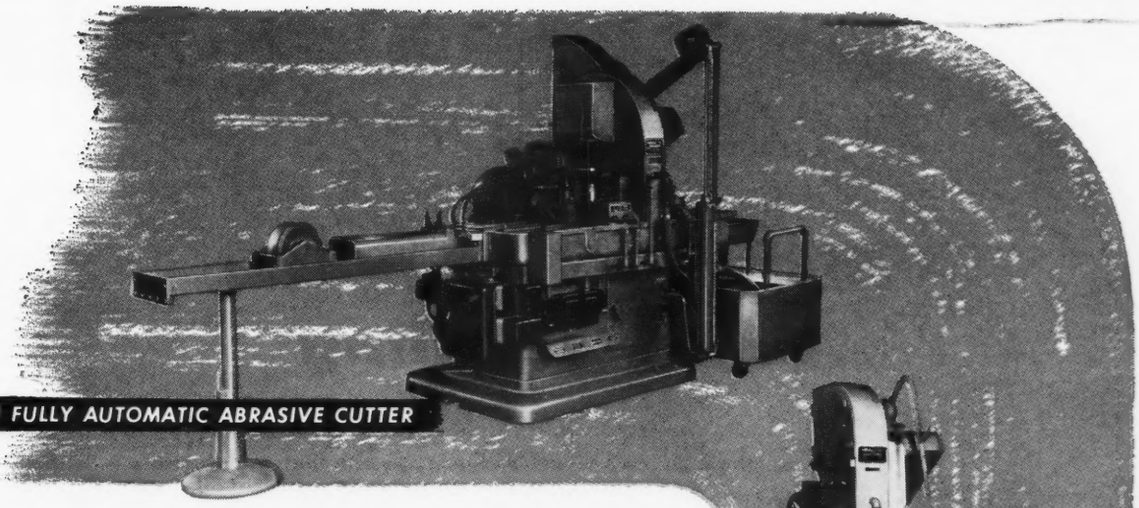
Ease of operation is assured due to centralization of controls on the head within easy reach of the operator at all times. Both table and arm swing in an arc of 360°. The adjustability of the table enables operator to locate the table in correct position for every job. It also enables him to swing the table out of the way in the event an emergency tall job comes up that may be mounted on the conventional base.

The Fosdick Sensitive Radial offers all the advantages of high speed sensitive drilling plus the versatility of radial design and construction.

The illustration shows an installation in a machine shop in eastern Pennsylvania. Whether yours is a production plant—a machine shop—or a tool room you'll find this machine is a most profitable investment.

For complete details write for the Fosdick Sensitive Radial Bulletin—S.R.M.

FOSDICK MACHINE TOOL *Company*
CINCINNATI 23, OHIO

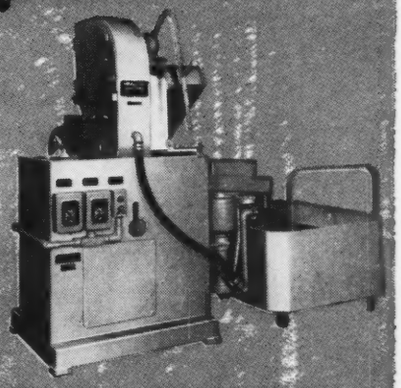


MODEL **470** FULLY AUTOMATIC ABRASIVE CUTTER

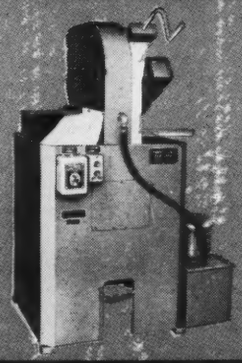
CAMPBELL

CUTTING AND NIBBLING

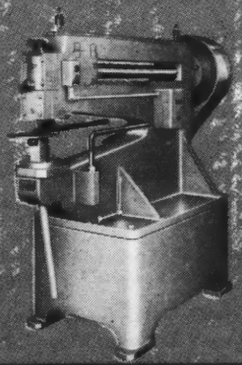
MACHINES



MODEL **223** ABRASIVE CUTTER



MODEL **15** ABRASIVE CUTTER



MODEL **530** NIBBLING MACHINE

ABRASIVE CUTTING Annealed or unannealed steel of any analysis, brass, bronze, monel, ceramics, phenol plastics, glass, tungsten, tantalum carbide—these and many other materials can be cut abrasively, in many cases cheaper and better than by any other method.

NIBBLING The efficient way to cut irregular shapes out of sheet steel (up to ½" mild steel, 5/16" stainless) where quantities do not justify making a special die. CAMPBELL offers a wide range of models for tool rooms, machine shops, experimental departments, sheet metal departments, production lines. Multiple speed and adjustable stroke provided.

Write us . . . . for detailed information about Abrasive Cutting, Nibbling, or both

ACCO

TRADE MARK

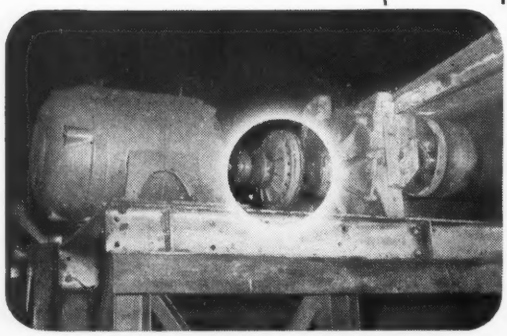
CAMPBELL MACHINE DIVISION
AMERICAN CHAIN & CABLE

925 Connecticut Ave., Bridgeport 2, Conn.

CAMPBELL Abrasive Cutters and Nibbling Machines

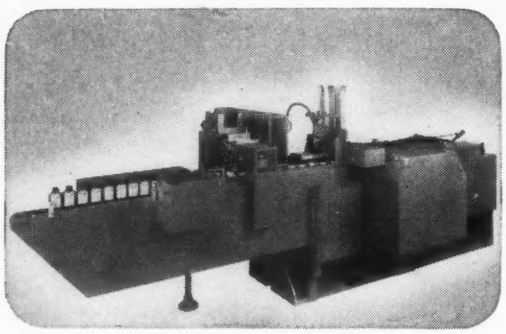
Kid Glove Power for product handling

Are you planning a conveyor or packaging machine that requires extra-smooth, steady power delivery . . . one that can't tolerate a "sticky" clutch with a jerky pace? Then it will pay you to check the following reports of Twin Disc shock-absorbing power links at work.



The Twin Disc Hydraulic Coupling* on this 500-foot coal mine conveyor cushions jolts of intermittent loading, starting and stopping . . . eliminates overmotoring at the start, prevents stalling of motor. *Ask for Bulletin 136.

To synchronize the two motors and prevent chain breaks on this pickling bin conveyor, a Twin Disc Hydro-Sheave Drive* was installed on each motor. The result was automatic synchronization of the motors, smoother operation, and a sharp reduction in maintenance costs and down-time. *Write for Bulletin 145-A.



This Redington cartoning machine, continuously on the job since 1944, drives smoothly, quietly and efficiently through a Twin Disc Model MTS Friction Clutch.* Unusually compact, this clutch has exceptionally high torque capacity and is engineered to fit easily into your design. *Request Bulletin 134-A.

Twin Disc engineers, specialists in power transmission, have helped many of the country's leading manufacturers solve their application problems. They will gladly consult with you . . . at no obligation, of course.

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

SPECIALISTS IN INDUSTRIAL CLUTCHES SINCE 1918

EVERDUR

Famous for exceptional resistance to corrosion, high strength, and adaptability to money-saving fabricating methods.

Cross sections, slightly enlarged, of special shaped wire and rod members.

Well screen being fabricated by unique method of resistance welding.

Micrograph of lengthwise section showing excellent fusion of Everdur resistance welds.

Johnson Well Screen, 16" O. D., 35' long, being lowered into well casing.

Longitudinal rods and outer wire in this Edward E. Johnson, Inc., well screen are both Everdur* 1010 and of special cross section. Fabrication of the screen is quickly and economically accomplished by rotating the rod assembly, thus winding on the wire and automatically welding wire to rod by electrical contact.

The circuit is arranged so that the rod assembly becomes one electrode, the other electrode being a copper roll which rides on the wire. As the latter touches each rod a surge of current welds the wire to the rod. Welding is at the rate of from 900 to 1700 welds per minute, depending on the size of the wire and rod. Only two or three cycles of current are required for each weld.

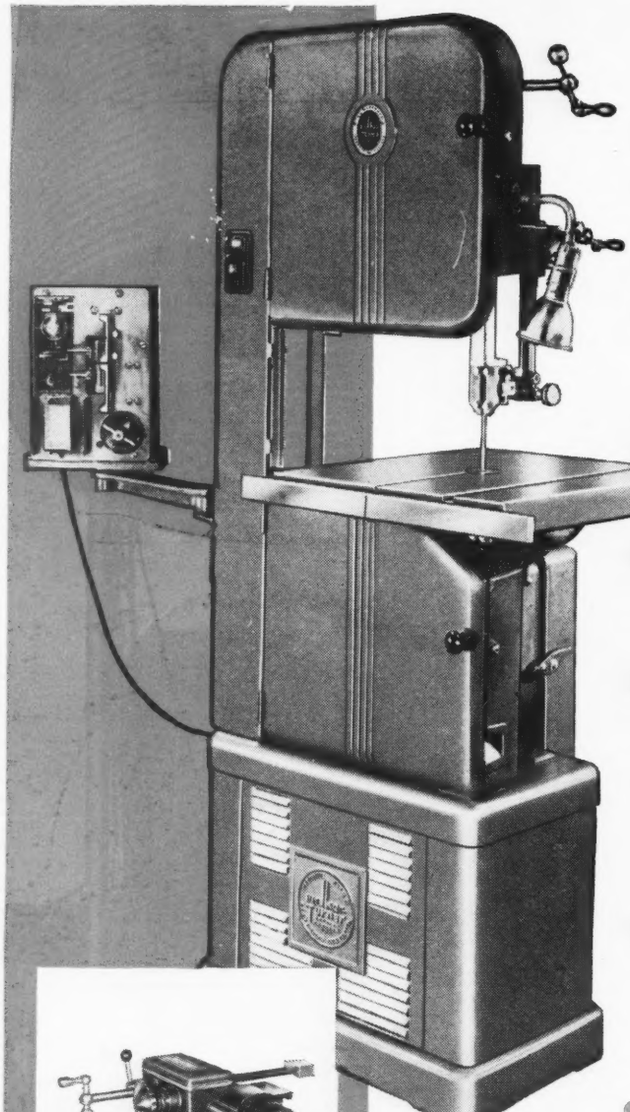
Everdur Alloys are non-magnetic and highly resistant to fatigue. Alloys are available which can be machined, hot-forged, drawn, stamped, spun, cast, electric-welded or oxy-acetylene-welded by all modern methods and equipment. For detailed information regarding compositions, properties, applications and advantages, ask for Publication E-5. Our Technical Department is at your service. Write The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 49158

Reg. U. S. Pat. Off.

Where corrosion resistance counts—consider Everdur

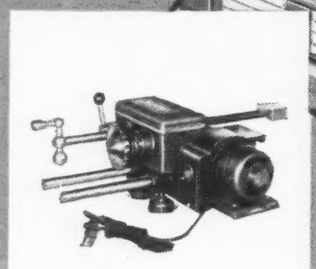
ANACONDA

COPPER-SILICON ALLOYS



Walker-Turner *design* makes this *new* 16" BAND SAW a *cost-cutting* machine!

. . . designed to cut metal-cutting costs.



NEW POWER FEED protects blade against distortion. Motor driven, it maintains a pre-set feeding pressure. Easily adjusted for blade condition and various types of material.

walker-turner DIVISION

You would expect this Walker-Turner machine to be efficient. But you'd have to *operate it,* in your own plant, to appreciate how quickly, accurately and economically this new 16" Band Saw cuts sheets, rods and tubes of steel, iron, aluminum, brass, alloys and compositions, or molded plastics.

Secret of its high operating efficiency is Walker-Turner *unit design.* Main column of the machine, for example, supports the two cast iron wheel housings, which in turn carry the wheel bearings and other elements of the saw.

Wheel housings are fitted with strong, lightweight covers that completely shield saw blades and wheels. Design improvements in upper and lower blade guides give maximum support to both wide and narrow saw blades. Easily adjusted roller provides back support on the upper guide. Every basic part is completely functional!

Find out more about Walker-Turner designing . . . how it can help you to increase production and lower machining costs. See your local authorized Walker-Turner dealer or mail coupon for catalog describing the complete Walker-Turner money-saving line.

Walker-Turner Division, Kearney & Trecker Corp.
Dept. M2, Plainfield, N. J., U. S. A.

Please send me a copy of the new Walker-Turner Catalog.

Name.....

Firm.....

City.....Zone.....State.....

KEARNEY & TRECKER MILWAUKEE

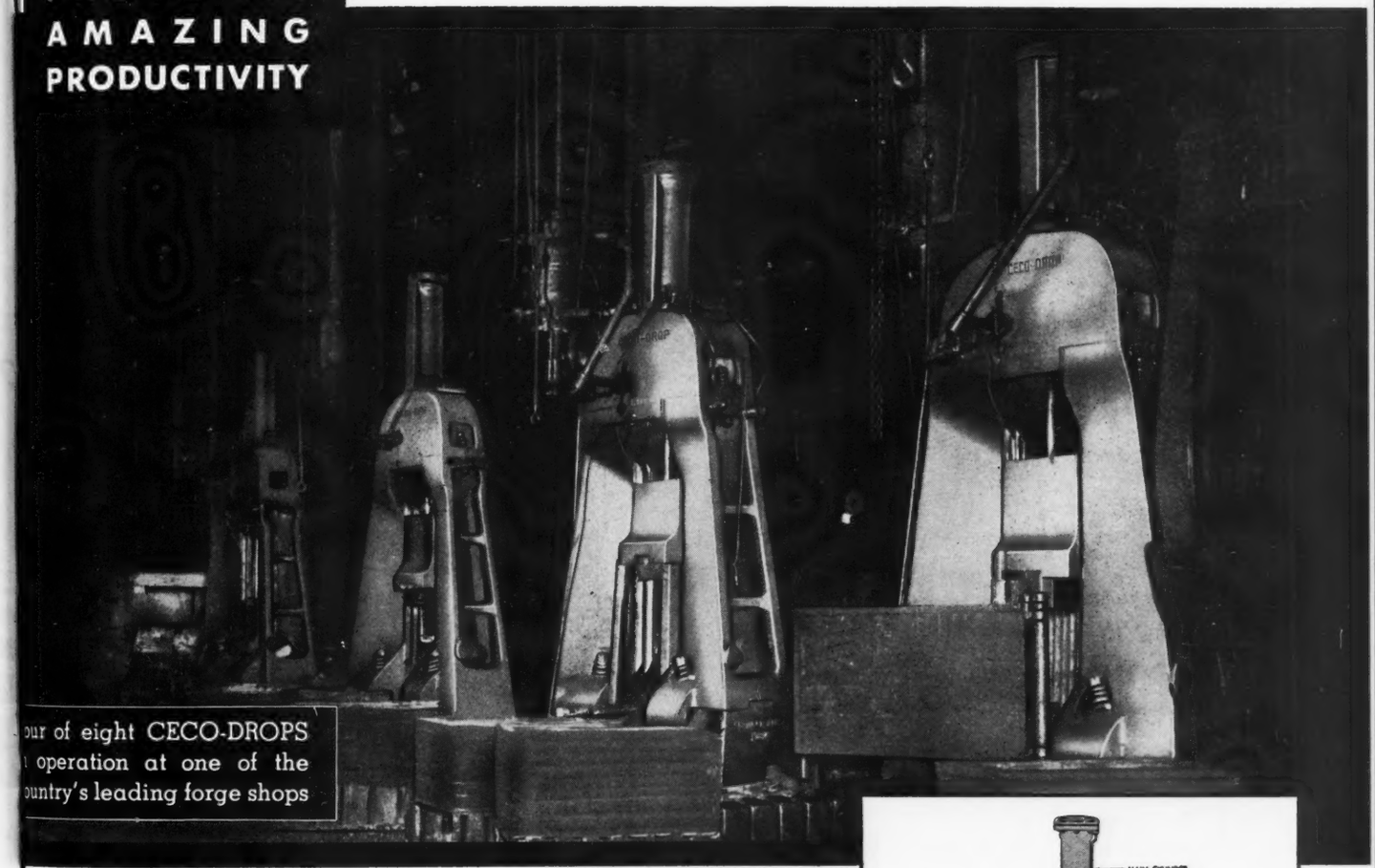
WALKER-TURNER DIVISION

PLAINFIELD, NEW JERSEY

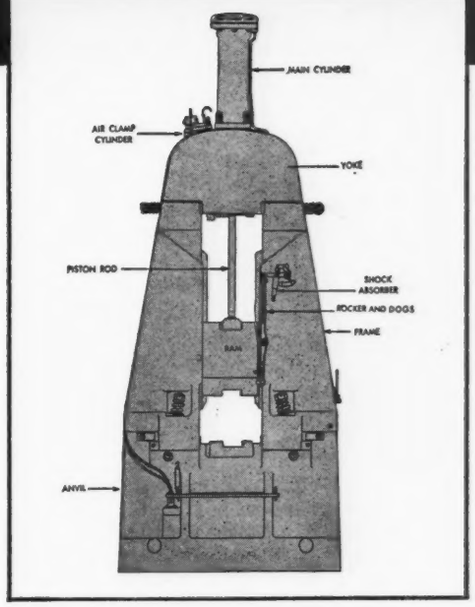
CECO-DROP

The Boardless Gravity Drop Hammer

REORDERS AND MULTIPLE INSTALLATIONS PROVE ITS AMAZING PRODUCTIVITY



our of eight CECO-DROPS
operation at one of the
ountry's leading forge shops



Costs less to operate . . .
Forges more minutes per hour . . .
Safer and easier to operate . . .

No Boards • No Front Rod • No Back Rod

This hammer is setting new records in cutting forging costs and in increasing production. Write for details.

CHAMBERSBURG ENGINEERING CO., CHAMBERSBURG, PA.

ARMSTRONG

TOOL HOLDERS . . . for every operation!

There are ARMSTRONG TOOL HOLDERS in sizes and types for every operation on lathes, planers, slotters and shapers—for the heaviest cuts; for the most delicate cuts.

With Standard shaped cutters, bits and blades of ARMSTRONG HIGH SPEED, ARMALOY (Cast Alloy) and ARMIDE (Carbide-Tipped) they provide a system of tooling that assures maximum production per machine hour, lower tool costs, and higher machining profits.

These permanent multi-purpose tools can be picked up as needed from your Industrial Distributor. Use them wherever possible to increase number of pieces per hour, to lower cost per pieces.

Write for our New S-48 Catalog.

ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

5213 W. Armstrong Ave. Chicago 30, Ill.

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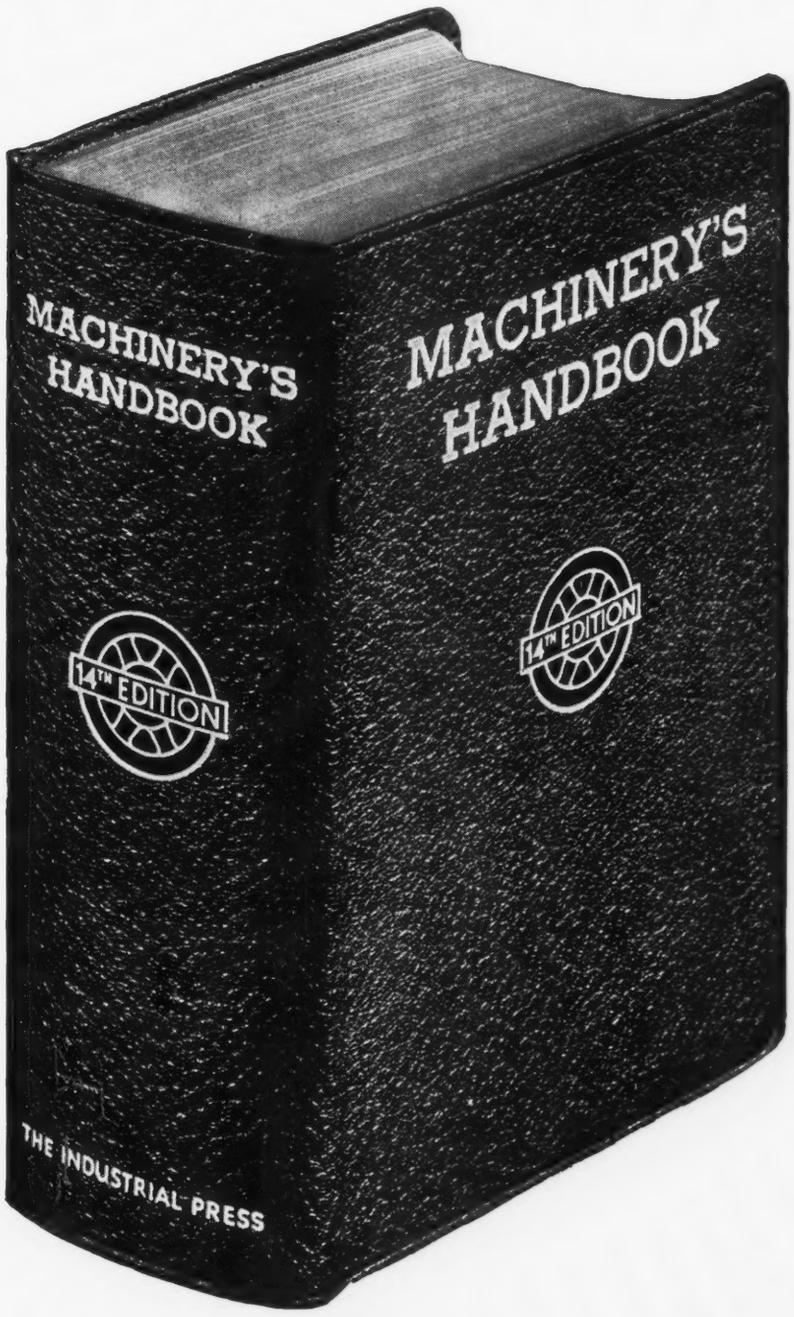
THE 14TH EDITION



Issued in December, '49

The "Bible" of the mechanical industries in a new edition which includes many important changes and much added data covering the latest manufacturing practices. Details on next three pages.

MACHINERY'S

The "Bible" of the Mechanical Industries

Price $7

1911 Pages
1367 Illustrations

For—Machine Designers
Mechanical Engineers
Tool Designers
Shop Executives
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Below is a list of the 136 main subjects or divisions in MACHINERY'S HANDBOOK. These main sections include thousands of items which may be located readily by the very complete index. A special thumb index provides for opening the book instantly to any one of the fourteen main divisions most frequently consulted.

Powers and Roots of Numbers
Circumferences and Areas of Circles
Circles and Spheres
Squares and Polygons
Prime Numbers and Factors
Transposition of Formulas
Ratio and Proportion
Percentage—Interest
Alligation
Arithmetical and Geometrical Progressions
Positive and Negative Numbers
Preferred Numbers
Equations
The Slide-rule
Logarithms
Hyperbolic Logarithms
Calculation of Plane Figures
Calculation of Solids
Pappus or Guldinus Rules
Contents of Cylindrical Tank at any Level
Circles and Equivalent Squares
Solution of Triangles
Natural Trigonometric Functions
Logarithms of Trigonometrical Functions
Geometrical Propositions and Problems
Standard Mathematical Signs, or Symbols
Standard Engineering Abbreviations
Standards for Drawings
Methods of Indicating Surface Finish
Composition and Resolution of Forces
Mechanical Powers
Center of Gravity
Moments of Inertia
Motion, Force and Work
Radius of Gyration
Centrifugal Force
Flywheels
Radians
Factors of Safety
Strength of Metals and Other Common Materials
Moments of Inertia Tables
Punch and Shear Frames
Section Moduli and Moments of Inertia
Properties of Shafts, Standard Pipe, and Structural Shapes
Beam Formulas
Structural Timbers
Strength of Columns
Strength of Flat Plates
Strength of Cylinders
Riveting and Riveted Joints
Wire and Sheet-Metal Gages
Wire Rope
Spring Design
Strength of Shafting
Friction
Design of Plain Bearings
Standard Ball and Roller Bearings
Lubricants
Keys and Keyways
Clutches and Couplings
Friction Brakes
Cams and Cam Design
Cam Milling
Spur Gearing
Bevel, Spiral Bevel and Hypoid Gearing
Worm-gearing
Helical Gearing
Herringbone Gears
Epicyclic or Planetary Gearing
Gear Measurement
Ratchet Gearing
Belts and Pulleys
V-Belt Drives
Pulley and Gearing Speeds
Chain Transmissions
Crane Chain and Hooks
Standard Bolts and Nuts
Standard Machine and Cap-screws
Standard Set-screws
Wood Screws, Nails, Spikes
Screw Thread Systems
Measuring Screw Threads
Allowances and Tolerances for Plain Fits
Standard Allowances and Tolerances for Screw Threads
Measuring Tapers and Angles
Rules and Constants for Setting Sine-bars
American Standard Gages
Tapping and Thread Cutting
Change Gear Ratios
Thread Milling
Thread Grinding
Thread Rolling
Change Gears for Helical Milling
Dividing or Indexing
Taps and Threading Dies
Milling Cutters
Cutter Grinding
Reamers—Twist Drills
Counterbores—Boring Bars
Standard Tool Shanks and Toolposts
Forming Tools
Punches and Dies
Broaches and Broaching
Files
Steels for Tools
Standard Taps
Knurls and Knurling
Jigs and Fixtures
Grinding, Polishing
Standard Grinding Wheels
Laps and Lapping
Cutting Speeds and Feeds
Tool Grinding
Cutting Fluids
Iron and Steel Manufacture
Tool and Structural Steels
Hardness Testing
Castings—Die-casting
Forging—Welding
Soldering, Brazing
Heat-treatment of Steel
Compositions of Alloys
Coloring Metals
Weights of Materials
Heat
Properties of Air
Hydraulics
Pipe and Pipe Fittings
Lutes and Cements
Standards for Electric Motors
Motor Characteristics
Electric Motor Applications
Electric Motor Maintenance
Manufacturing Plant Appraisal
Weights and Measures

S HANDBOOK

The 14th Edition

An Engineering Reference Book Used Throughout the World by Designers and Builders of Everything Mechanical

Some Important Additions and Revisions in the 14th Edition

MACHINERY'S HANDBOOK throughout its long and useful life has been revised before each printing to keep abreast of engineering developments. The object has been to make not only every edition, but each successive printing, of greater practical value than any preceding one. Perhaps this explains why so many have referred to MACHINERY'S HANDBOOK as the "Bible" of the engineering field. This book has been designed to serve as a working tool for daily use. Some important additions and revisions of the 14th Edition are summarized below.

Unified Screw Thread Standard

This important revision is to provide interchangeable screw threads in the United States, Canada and the United Kingdom. In the HANDBOOK section on screw thread systems, the general features and basic dimensions of the Unified Standard are given (pages 986 to 990). This international standard applies chiefly to new classes of screw thread limits and tolerances.

Classes of Screw Thread Limits and Tolerances

Practical application of the new Unified and American Standard for Screw Threads requires tables giving the external and internal thread limits. Such tables will be found in the section on Tolerances and Allowances, pages 1084 to 1107. Bold and lightface types in the tables show which figures represent the Unified Standard and which apply only to the American Standard.

Broach Design

The revised designing data on this subject relate to such factors as depth of cut per tooth, face angle, clearance angle, land width, tooth depth, fillet radius and pitch of the teeth. One pitch formula gives the minimum value as fixed by the receiving capacity of the chip space. A second formula gives the allowable pitch as determined by the usable power of the broaching machine, which is taken at 70 per cent of the maximum tonnage. The section includes broach steels and tabulated data for designing surface broaches.

Electric Motor Standards

Revision of the mounting and other dimensions as standardized in the United States by the National Electrical Manufacturers' Association. Tables give the dimensions needed by designers in the practical application of motor drives.

Types of Motors

This new section deals with the generally used types of d-c and a-c motors and their operating characteristics. The information is intended for the general use of machine designers who want to know about important factors governing motor selection and the relation between different types and their adaptability to different classes of service. A two-page chart shows the characteristics and common applications of different classes.

Sharpening Carbide Tools

The practice described represents the recommendations of forty prominent machinery and abrasive manufacturers. Specific information is given on the types of grinding wheels, their selection and application; also the pros and cons about wet versus dry grinding.

Worm Gearing

A two-page chart containing the commonly used formulas; design of worm gearing when both ratio and center distance are fixed, and also when either of these values may be varied; materials used for worm gears; the purpose of the hunting tooth or self-indexing action in worm gear design; operating temperatures; water and forced air cooling; efficiency and horsepower rating for both wear loads and strength loads.

Preferred Series of Basic Sizes

The basic sizes in this American Standard are intended to reduce the number of different diameters commonly used in a given size range, thus also reducing the number of sizes of bar stock, bushings, drills, reamers and gages. Preferred tolerances and allowances are also included as a logical complement to preferred sizes.

Roller Chains

This extensively revised section includes recommended maximum sprocket speeds for various tooth numbers and chain pitches; horsepower ratings tabulated for different pitches; speeds and small sprocket sizes, standard chain dimensions; standard sprocket dimensions; standard tooth forms; standard space cutters for sprockets.

Standard Steels

Revised standard compositions for 156 carbon and alloy steels approved by the Iron and Steel Division of the SAE and by the American Iron and Steel Institute. Considerable information also is given on typical practical applications of the various steels.

Aluminum Alloy Temper Designations

These temper symbols or designations apply to a large range of aluminum alloys, including heat-treated and non-heat-treatable alloys. This is a standard adopted by the Aluminum Company of America.

Precision Investment Casting

Summary of important facts about this highly developed process of producing intricate castings of great accuracy. It is applicable to various ferrous and non-ferrous alloys, including alloy steels. The accuracy of the process may, in general, compare favorably with that of many machined parts.

Hardness Scales and Conversion Tables

These revised tables show the relationship between Brinell, Rockwell, Vickers, and scleroscope scales. The tables include Brinell scales for both 500 and 3000 KG loads and also Rockwell scales A, B, C, D, E, F, G, H, K, 15-N, 30-N, 45-N, 15-T, 30-T, 45-T.

Machine Screws and Cap-Screws

Revised American Standard, including an addition to the common forms of machine screws with the 100 degree flat head, the pan head, the binding head, and the truss head. The standard also contains different forms of cap-screws.

Standard Spur and Helical Gears

This standard applies either to machine cut or ground spur gears and also to single and double helical gears connecting parallel shafts. It is a revision of the British Standard and includes horsepower formulas for rating gears both with reference to the tooth strength and as limited by tooth wear.

See Next Page for More Information

Will Your Present Handbook Answer Questions Like These?

The Sample questions below indicate the up-to-date character of MACHINERY'S HANDBOOK. You will find the answers to thousands of practical questions like these in the Fourteenth Edition.

What important changes have been made in the American Standard Screw Thread system in order to provide a Unified interchangeable standard for the Dominion of Canada, the United Kingdom, and the United States?

How many new classes of limits are included in the Unified and American Standard and have any of the former classes been retained?

Is the Unified Standard interchangeable with the former American Standard?

In designing worm gears, why is it common practice to select a number of wheel teeth that is not an exact multiple of the number of worm threads?

In determining the pitch of broach teeth, how would you establish the pitch relative to the broaching load and available tonnage of the broaching machine?

Place your order now for this authoritative reference book. Use the coupon below with Refund Offer.

Under what conditions would you use (1) a ball bearing of non-loading groove type; (2) a loading groove type?

What factors govern the power transmitting capacity of silent chain drives?

In grinding screw threads, what types of wheels are used?

If the highest degree of accuracy is required, what thread grinding method is employed?

In machining magnesium, is a cutting fluid generally used and, if so, what kind?

Tools for machining magnesium should have certain features or characteristics. Can you name the important ones?

What is the general procedure in stabilizing or "seasoning" precision gages by the sub-zero method?

Why is the sub-zero method effective in preventing subsequent changes in the form or size of a gage or precision machine part?

What, in general, are the advantages of the powdered metal process of forming duplicate machine parts?

What general types of ball and roller bearings have been standardized by bearing manufacturers?

Under what conditions are soluble oils generally used for machining operations?

Is it practicable to use standard or commercial twist drills for drilling plastics?

In quenching steel for hardening, what is the object of interrupted quenching methods such as austempering, martempering, and isothermal quenching?

Why are some high-speed steel tools hardened by quenching in a bath of molten salt?

Under what general conditions is induction hardening particularly applicable?

If an aluminum alloy is designated by the symbol 24S-T4, what does this standard symbol indicate?

How would you determine the oversize or grinding allowance for a worm gear hob intended for general work?

What is the usual range of feeds per work revolution for carbide forming tools?

What are the usual methods of machining non-metallic gear blanks made from laminated phenolic plastics?

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M-2/50

10" x 3-1/2', 1" Collet, Quick Change Gear Lathe with 3/4 h.p., 3 phase, 60 cycle, 220 volt motor and switch; f. o. b. factory **$941.35**

Time Payments: $235.35 down payment, $62.36 for 12 months.

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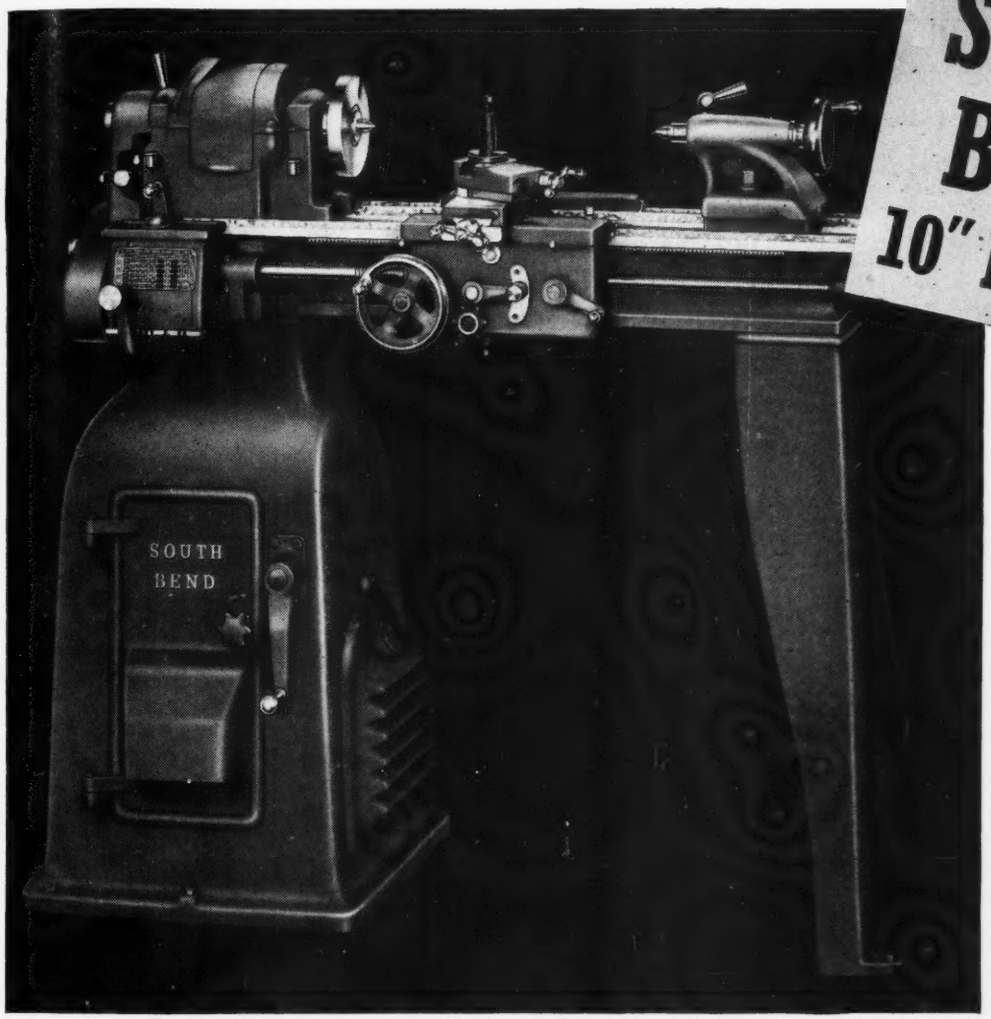

Keep Machining Costs Down

If you are machining small parts to close tolerances, there is a good possibility that South Bend 10" Lathes can help you keep machining costs down.

This is the type of work that they do best. Their accuracy simplifies holding exact tolerances on any operation. Smooth finishes, that often eliminate subsequent operations, result from the vibration-free drive and large bearing areas. They are economical of manpower — handling is simplified, fast and nearly effortless. You will also find that their versatility keeps them busy . . . they are highly adaptable to a wide variety of jobs.

It's costly to use over-sized and over-powered lathes for your small, precision parts. It will pay you to find out about South Bend 10" Lathes. *Write now.*

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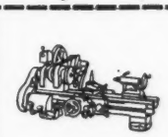
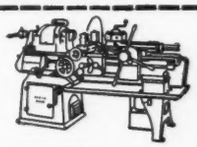
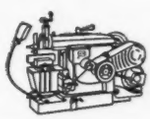

☐ BENCH LATHES 9" and 10" ☐ TURRET LATHES ½" and 1" Collets ☐ 7" BENCH SHAPERS ☐ 14" DRILL PRESSES

☐ PRECISION LATHES 10", 13", 14½", 16", 16/24" ☐ LATHE TOOLS and ATTACHMENTS ☐ TIME PAYMENT PLAN

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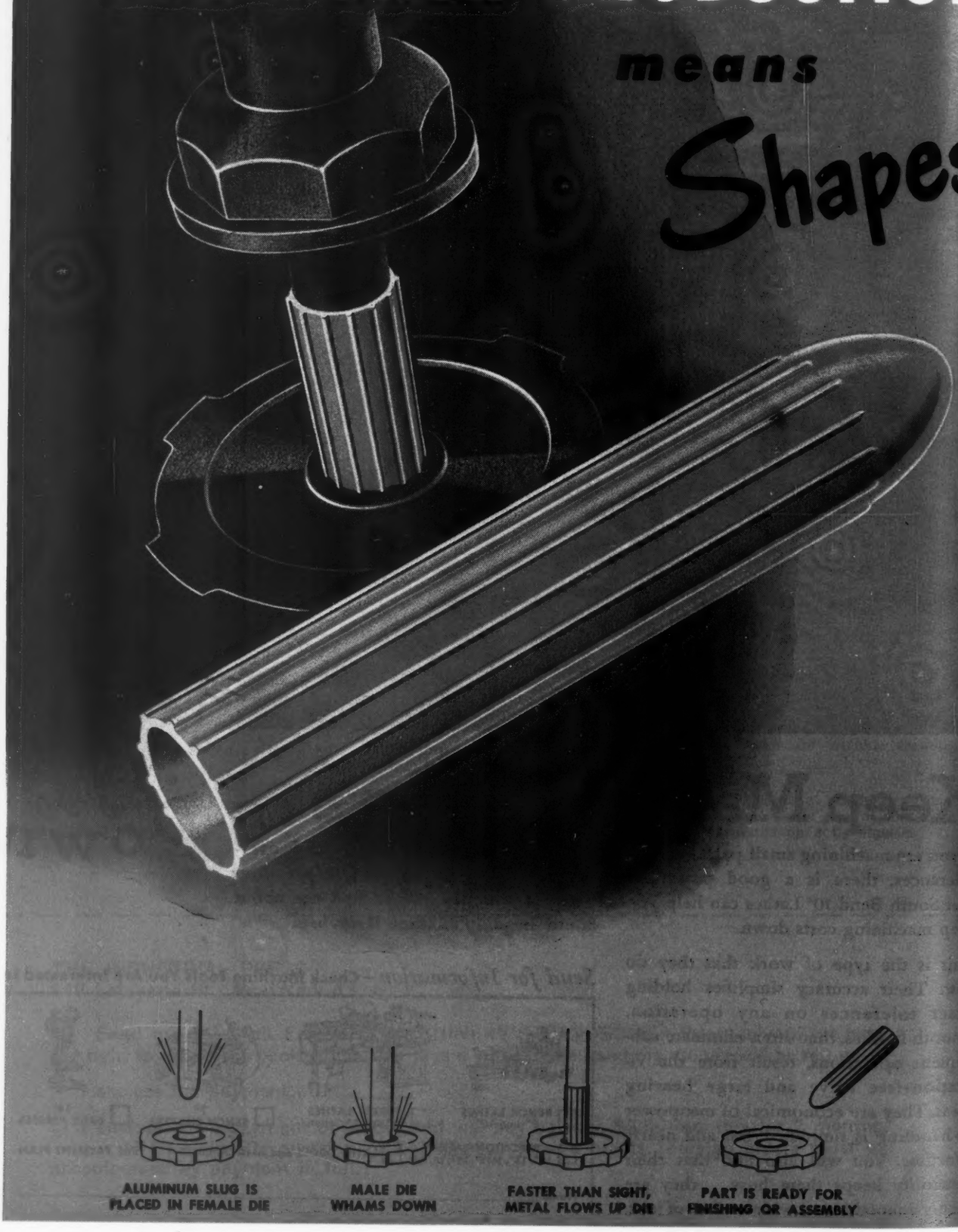
ONE-PUNCH PRODUCTION

means

Shapes


ALUMINUM SLUG IS PLACED IN FEMALE DIE
MALE DIE WHAMS DOWN
FASTER THAN SIGHT, METAL FLOWS UP DIE
PART IS READY FOR FINISHING OR ASSEMBLY

Here's what we mean by "One-Punch Production"

like this can cost less

as ALCOA IMPACT EXTRUSIONS

Can you visualize your product—or any part—as a hollow symmetrical shape? If the answer is yes—or maybe—Alcoa Impact Extrusions offer a way to get it made faster and cheaper. Cheaper than stamping, spinning, drawing, turning. And with sales-winning attractiveness.

Alcoa's split-second production process turns out complex or simple shapes in one all-productive "smack". Quicker than your eye can follow. Complete with ribs or flutes or bosses or other embellishments that would consume more time and require more costly dies by any other process.

If you see possibilities in this process for your product, call your Alcoa representative for more information about it, and for your free copy of "Alcoa Impact Extrusions."

Or write ALUMINUM COMPANY OF AMERICA, 2141B Gulf Building, Pittsburgh 19, Pennsylvania.

Imagineering with Alcoa Impact Extrusions lets you do any or all of these things:

LOWER YOUR COSTS—dies for Alcoa Impact Extrusions cost less than drawing dies. The difference is your savings.

CHOOSE ALMOST ANY HOLLOW SHAPE—virtually any symmetrical hollow shape can be impact extruded.

DESIGN FOR LENGTHS up to 12" and diameters to 5". Greater diameters and lengths possible varying according to design.

VARY THE WALL THICKNESS for decoration or function. Lugs, fillets, bosses, stems, necks; design for thin sides with thick bottoms—at no extra cost.

CHOOSE ANY FINISH that's commercially practical. Polish, etch or satin-finish the bare aluminum. Lacquer, paint or lithograph it. Or specify plain or colored Alumilite*, the satiny oxidized finish available only with Aluminum.

MACHINE THE PART to add flanges, inside, outside curl beads, internal or external beads, threads. Parts need less machining, machine faster. You get this saving, too.

GET PARTS ON TIME—Alcoa will deliver completed impact extrusions, ready for finishing, or dependable delivery dates.

*Patented process

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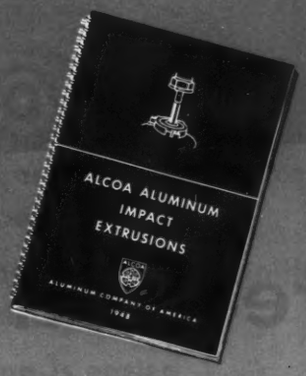


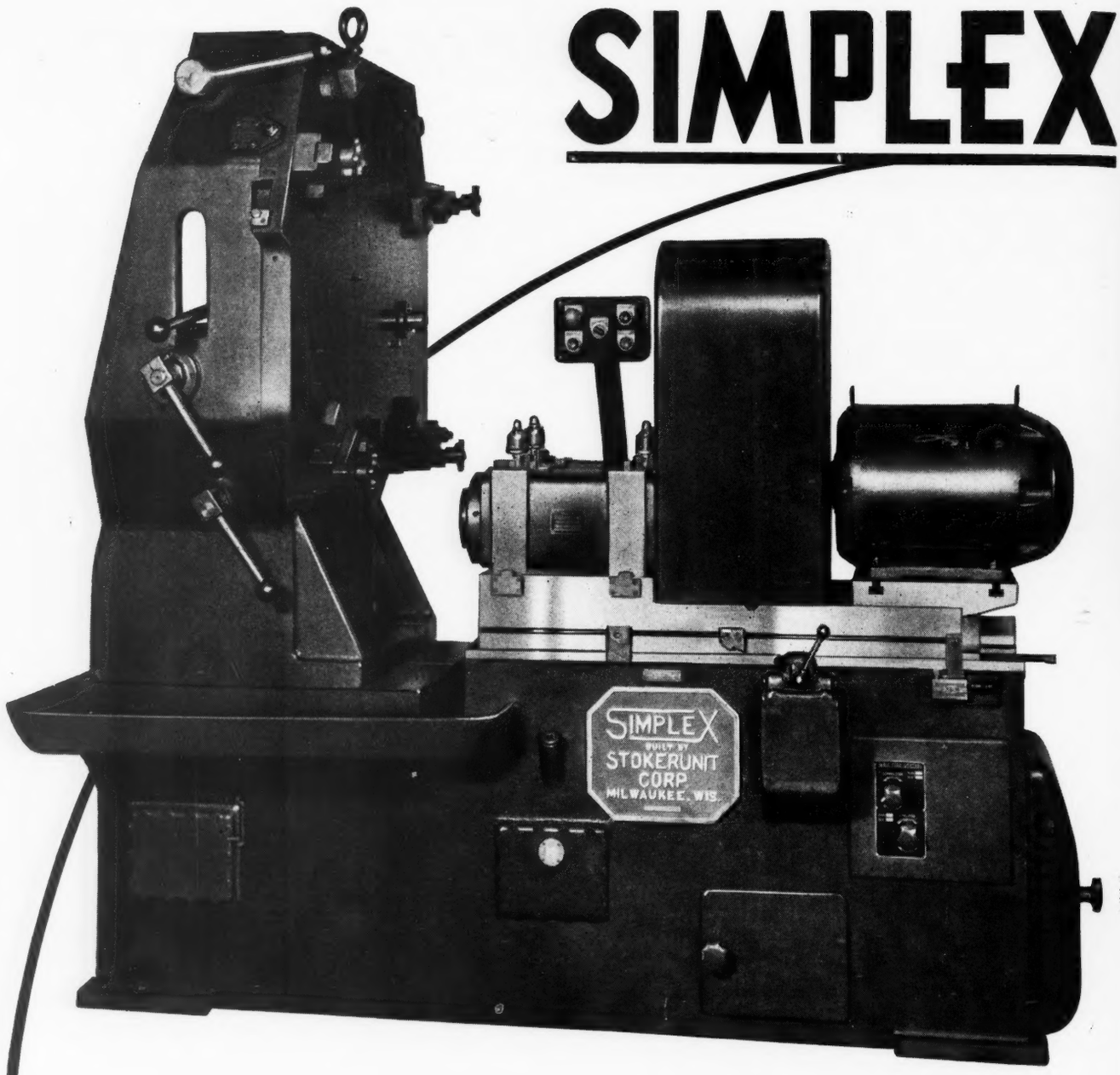
Send a request on your letterhead to Alcoa for your free copy of "Alcoa Aluminum Impact Extrusions". Fully explains Alcoa's Impact Extrusion process and service. Shows whole range of shapes for imagineering.

ALCOA ALUMINUM

IMPACT EXTRUSIONS

From slugs to shapes in split seconds

SIMPLEX



Precision Boring Machines

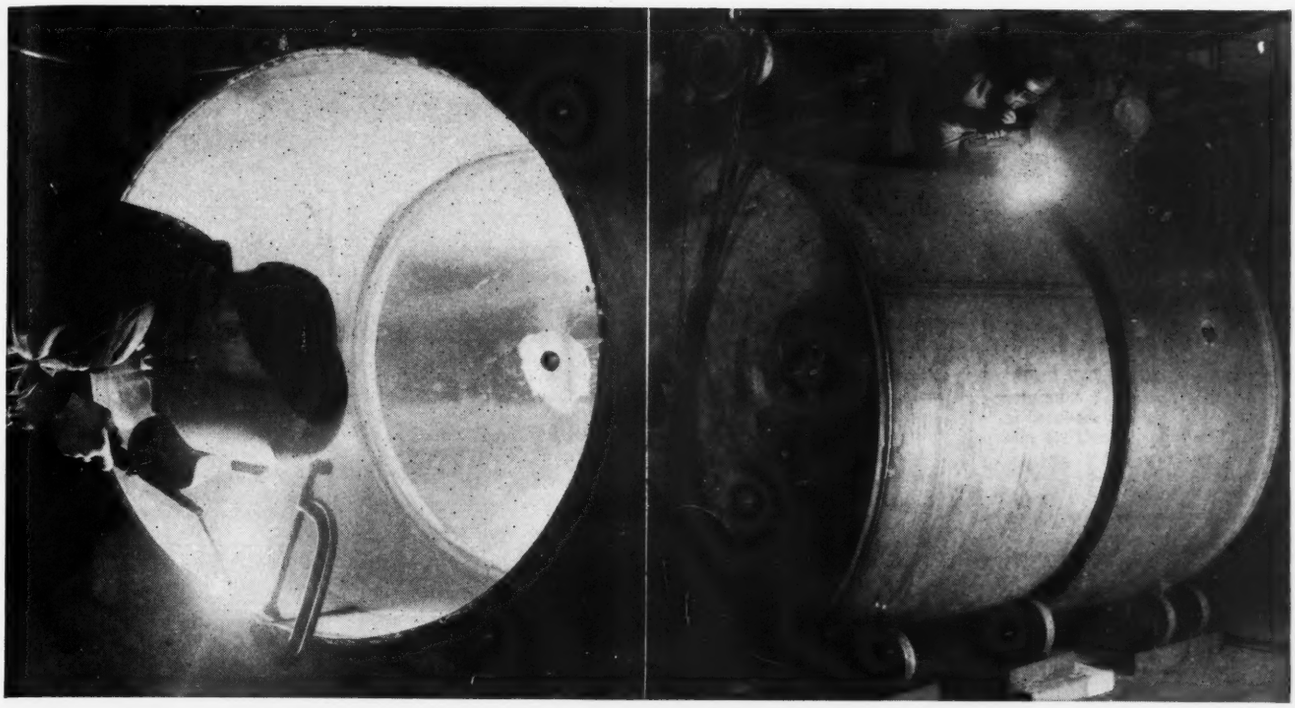
Did you know that precision boring has grown up? It is no longer confined to jobs you can carry around in your hat. Today pieces as large as your desk are being precision bored for military purposes. Tomorrow similar pieces will be precision bored for commercial purposes. Now is the time to be considering these applications in your own plant.

The machine shown above is one model. Other larger and more versatile units have been built and more are coming. Our catalogue will give you a more general picture. Our dealers will help answer your specific needs. Ask for our catalogues on your letterhead, without obligation. Our engineering surveys are available for your problems.

STOKERUNIT CORPORATION

SIMPLEX Precision Boring Machines and Planer Type Milling Machines

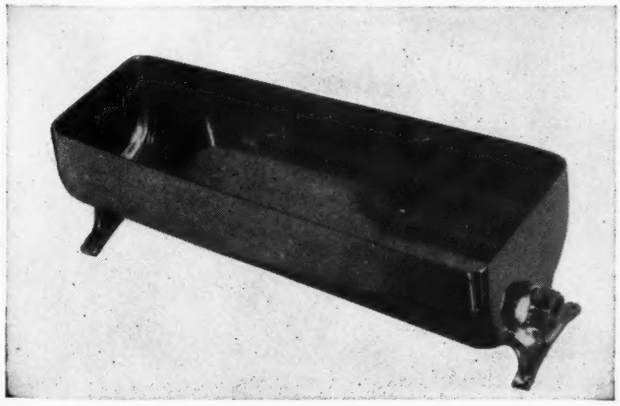
4526 West Mitchell Street, Milwaukee 14, Wisconsin



Above left: Welding cylindrical tanks at S. Blickman, Inc., Weehawken, New Jersey, with new "Stainweld".
Above right: Downhand welding 18-8 stainless steel 1200 gallon still.

NEW LINCOLN ELECTRODES CUT STAINLESS WELDING COSTS

All types of stainless steel pressure vessels and containers are now being weld fabricated at lower cost with new, improved Lincoln "Stainweld" electrodes. As a result of newly developed coating, new "Stainweld" offers these cost cutting advantages:



Stainless steel trough shows high quality welds ground and polished. Courtesy S. Blickman, Inc.

- **Welds easier in flat, vertical and horizontal positions.**
- **Arc is more stable... simplifies welding in corners.**
- **Restriking is easier.**
- **Spatter is less... slag removal is better.**
- **Welds are more solid... greater freedom from pin holes.**
- **Bead surface is more uniform... needs less finishing.**

GET THE FACTS

Send for free Lincoln Weldirectory for Stainless Steel.
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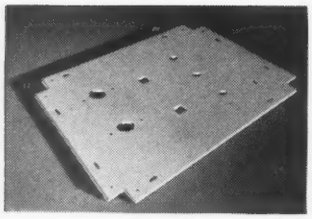
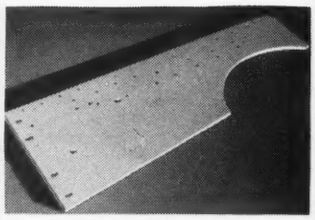
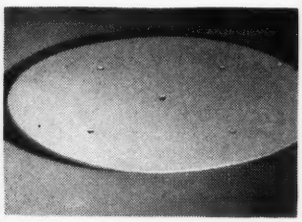
LINCOLN



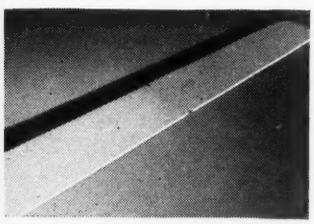
The first **radio chassis,** 10"x 14", with 27 holes and 4 notches shown above was produced including setup in only 9.3 minutes and subsequent pieces in only . . . **1.8 min.**



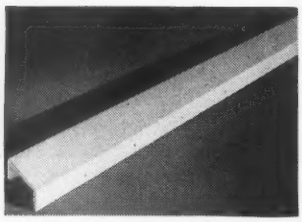
A part of a piece of **farm equipment,** 72½"x 22", with 32 holes and nibbled cut-out was finished including setup in only 12.01 minutes, subsequent pieces in **2.32 min.**



Above circle, 24" in diameter with OD nibbled and 5 holes punched was produced in only 4.26 minutes including setup and subsequent pieces in only **2.38 min.**



An **electric refrigerator** part, 39⅞"x 8½" with 10 holes and 4 notches was fabricated including setup in only 5.61 minutes and subsequent pieces in only . . . . . **37 sec.**



An **automotive** channel, 28" long with 12 holes was fabricated including setup in only 3.37 minutes and subsequent pieces in only **29 sec.**

Can you match these WALES FABRICATOR TIME STUDIES *with your present methods?*

● These time studies were made under actual production conditions with average operators and were taken at random from hundreds of time studied parts.

There is nothing like this revolutionary Wales Fabricator. It punches, notches and nibbles. Wales exclusive Hydra-New-Matic Drive is unique in its simplicity of design and operation...so unique, in fact, that vibration and noise is practically eliminated at 165 strokes a minute. This drive plus the Wales patented "Quick-Change" System makes possible these startling "never-heard-of-before" time study figures.

IT'S TOO BIG A STORY TO TELL ON THIS PAGE, so write for fully-illustrated, functionally-colored Catalog 10-A and discover for yourself why production schedules of this Fabricator have been more than doubled.

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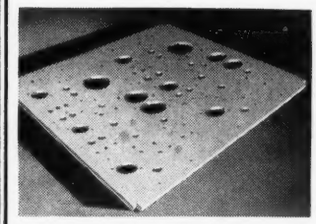
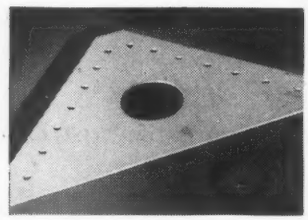
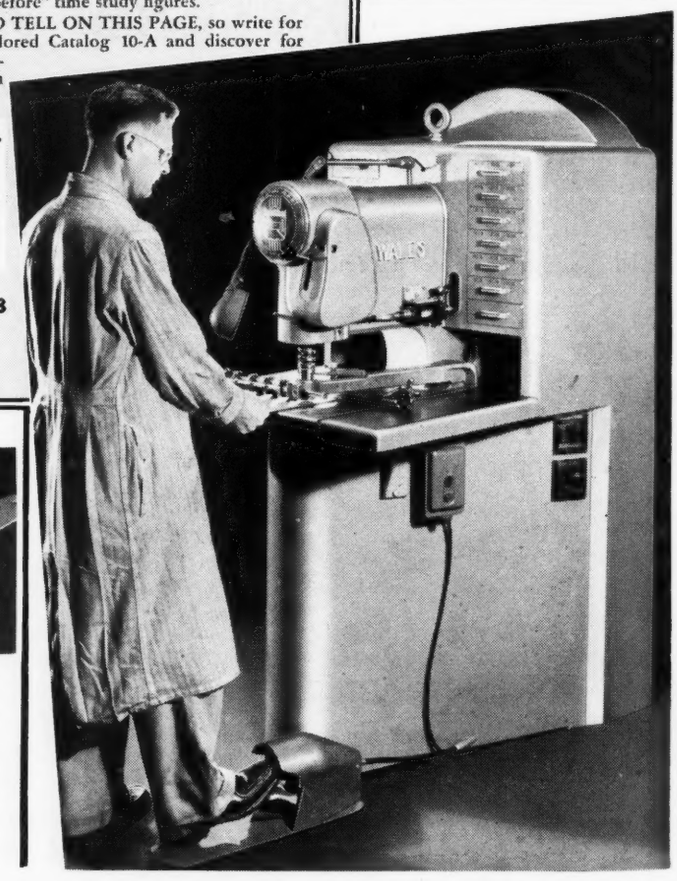
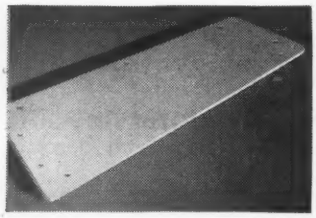


Above **electronic chassis,** 12½"x 11½", with 118 holes and 4 notches was completed including setup in only 32.45 minutes and subsequent pieces in only **6.44 min.**

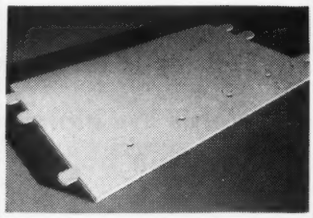


An **aircraft** gusset plate 7½"x 4½" with 15 holes and 1 notch was produced including setup in only 3.52 minutes and subsequent pieces in only . . . . . **54 sec.**





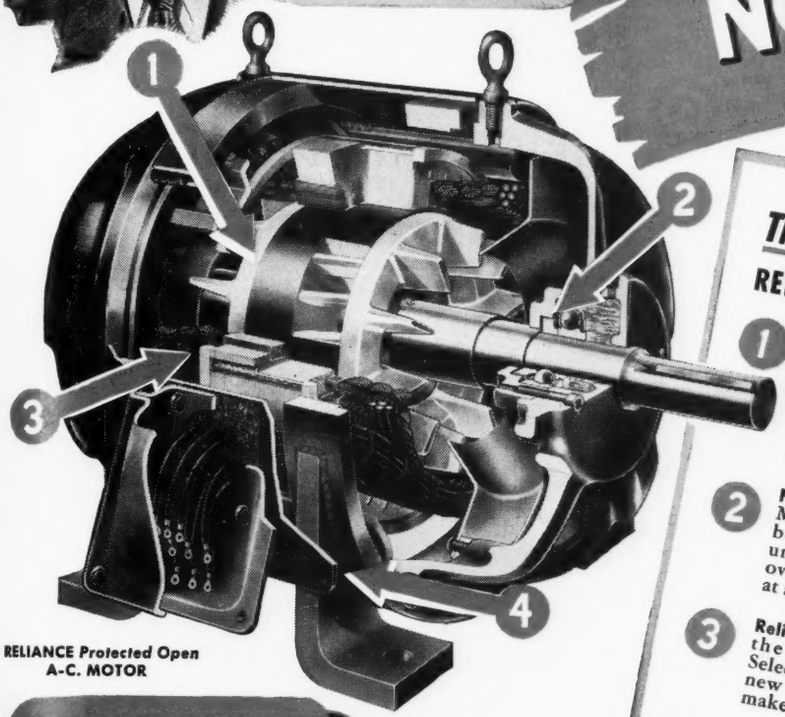
A piece of work, 11¼"x 24", with 9 holes and 4 notched, rounded corners was produced including setup in only 4.99 minutes and subsequent pieces in only **41 sec.**



The above piece of work, 22¾"x 9½" with 4 holes and 2 sides notched and nibbled including setup was produced in only 6.10 minutes and subsequent pieces in only **1.2 min.**

WHY HASN'T SOMEBODY TOLD ME THIS BEFORE?

"...all motors are NOT ALIKE"



RELIANCE *Protected Open* A-C. MOTOR

These 4 Advantages Alone make RELIANCE the motor that is different!

1. **Dynamic Balancing—Precision Fits**—Every motor is dynamically balanced by skilled technicians using latest electronic-principle equipment. Machining of parts to exacting tolerances guarantees precision fits throughout. Result: a smoother-running, longer-lasting motor!
2. **No Lubrication Worries**—Precision Bearing Mounting, with double-shielded ball bearings, assures longer bearing life under all normal conditions, whether overgreased, undergreased or not greased at all. "*You can't grease 'em wrong!*"
3. **Reli-X Insulation** furnishes a new high in the protection of stator windings. Selected materials, exclusive methods and new continuous-sequence applications make this the *unfailing* insulation!
4. **Steel for Strength**—Steel construction, with electrically welded joints, combines maximum strength with minimum weight.

RELIANCE *Precision-Built* **MOTORS**

...are made *better* to deliver DEPENDABLE POWER—LONGER!

Reliance has a way of building motors that must be seen to be fully appreciated. Any time we can take a motor user through the modern plants where Reliance *Precision-Built* Motors are made, we can be reasonably sure of another good Reliance customer. We would be delighted to have you make this visit. But if it isn't practical, call in your nearest Reliance representative and *see* the convincing facts he can show you on the precision methods that produce these truly superior motors. Now available from ¾ to 300 horsepower.

HOW TO SELECT THE RIGHT MOTOR

Here's a book which digests all the information you should have in selecting the motor that's just right for any job. New torque and current standards recently adopted by the National Electrical Manufacturers Association for A-c. motors are tabulated and explained. And these are further supplemented by more detailed performance data on Reliance *Precision-Built* Motors. Write today for this important new Motor Data Bulletin, B-2101.

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Only MARVEL *builds all four**

***HACK SAWING MACHINES**

***BAND SAWING MACHINES**

***BAND SAW BLADES**

***HACK SAW BLADES**

While it is true there are several builders of hack sawing machines and many builders of band sawing machines, only MARVEL builds **BOTH** hack saws and band saws. The fact is that MARVEL manufactures 35 models of 10 basic types of metal sawing machines which include the world's fastest automatic production saw, the world's largest giant hydraulic hack saws, the world's most versatile band saw and the most widely used small shop saws.

With intimate and broad field experience in all types of metal cutting-off equipment and 35 different saws available, it is obvious that MARVEL Field Engineers occupy a unique and exclusive position in the industry. They are eminently qualified to make expert and **unbiased** recommendations covering the type, size and model of metal sawing equipment best suited to individual requirements — the most efficient, most accurate, fastest, broadest in scope and the most economical.

MARVEL is also the only manufacturer of both metal sawing **machines** and metal sawing **blades.** Because the efficiencies of both the machine and the blades are interdependent, each upon the capability of the other, expert knowledge covering both saws and saw blades is essential to the proper appraisal of any specific sawing situation. Correct balance of cutting speed and blade life, feed pressure and blade tension are all potent factors in over-all performance. Here again it is the MARVEL Field Engineer who is qualified to provide the comprehensive answer to your question. His job is to help you saw metal most efficiently—his services are available upon request—gratis.

Write for Catalog 49

ARMSTRONG-BLUM MFG. CO.
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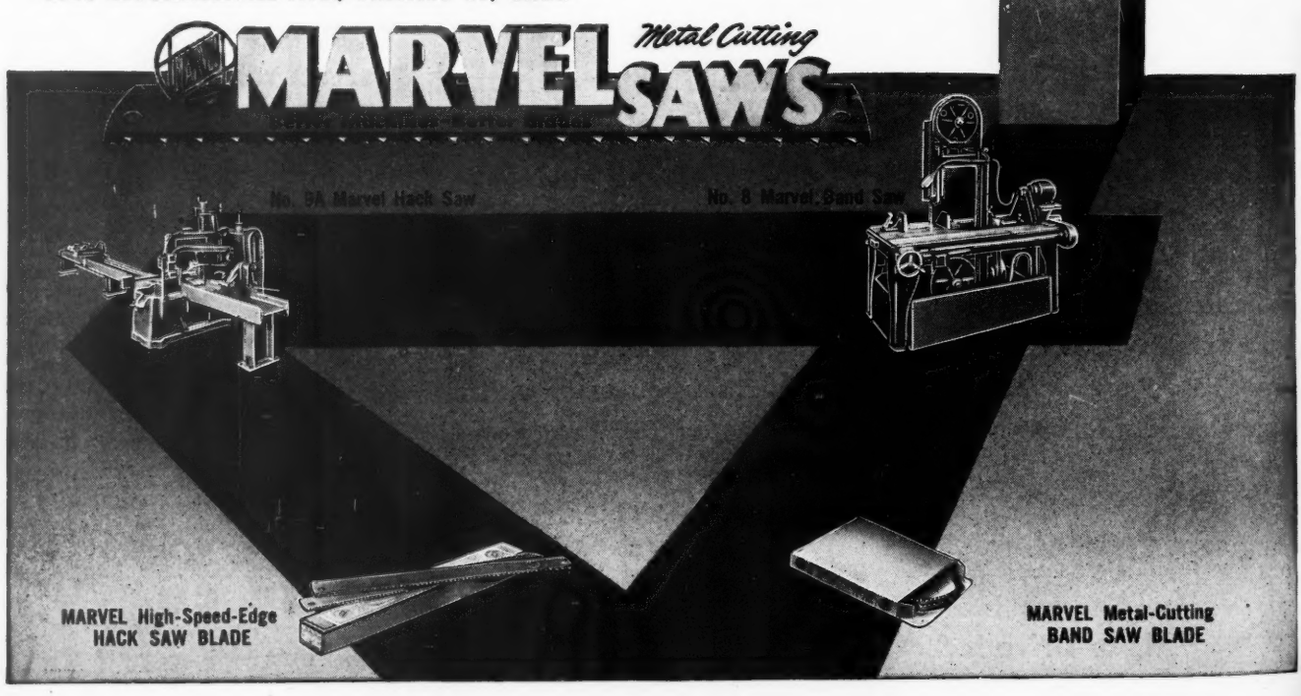
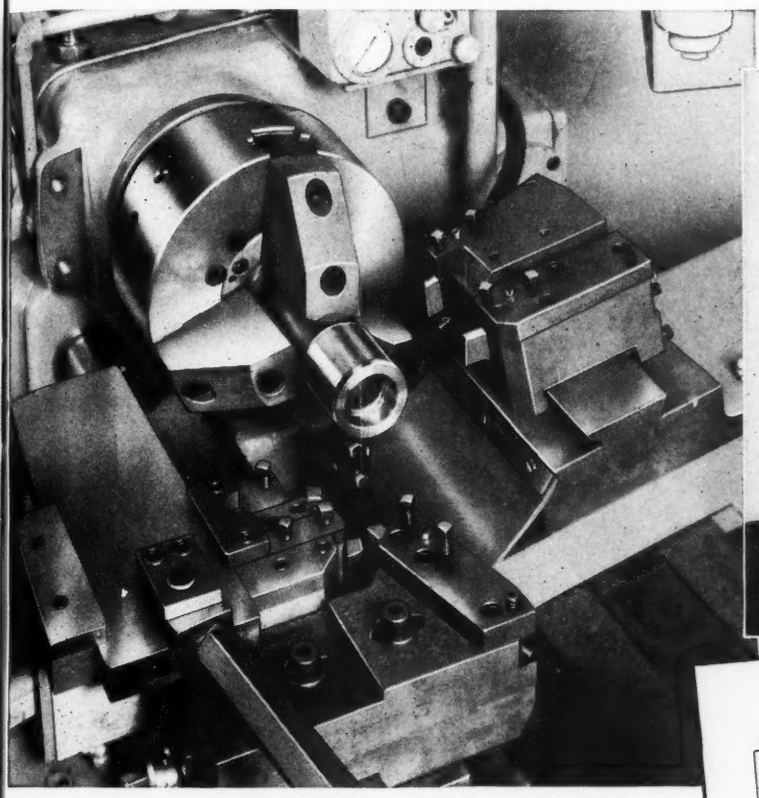
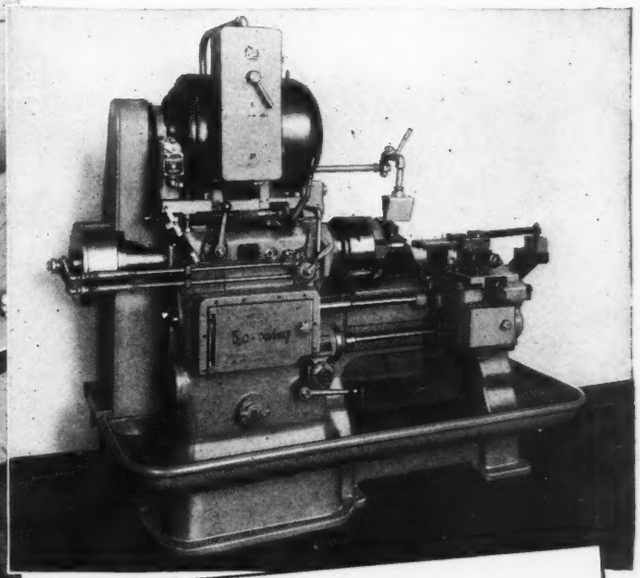
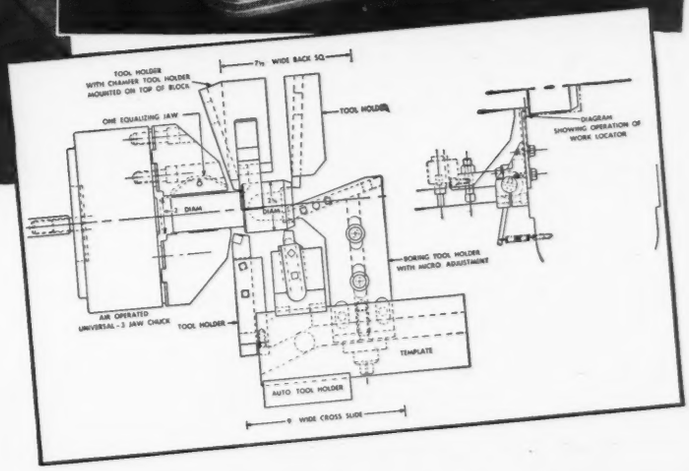

MARVEL Metal Cutting SAWS
No. 9A Marvel Hack Saw
No. 8 Marvel Band Saw
MARVEL High-Speed-Edge HACK SAW BLADE
MARVEL Metal-Cutting BAND SAW BLADE

MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. **"THE Lo-swing PEOPLE"** SENECA FALLS, NEW YORK






TOOL HOLDER WITH CHAMFER TOOL HOLDER MOUNTED ON TOP OF BLOCK
7½ WIDE BACK SQ.
ONE EQUALIZING JAW
TOOL HOLDER
DIAGRAM SHOWING OPERATION OF WORK LOCATOR
BORING TOOL HOLDER WITH MICRO ADJUSTMENT
AIR OPERATED UNIVERSAL - 3 JAW CHUCK
TOOL HOLDER
TEMPLATE
AUTO TOOL HOLDER
9 WIDE CROSS SLIDE

Lo-swing CUTS COSTS ON

CHUCK WORK

Problem: To turn and chamfer outside diameter, face both ends and bore inside diameter of Idler Shafts in a single automatic operation.

Solution: The Model LR Automatic Lo-swing Lathe selected for this job was equipped with a 10″ three-jaw, air-operated chuck having one jaw fitted with a swivel key to compensate for irregularities on the forged stem. The large diameter is turned and the bevel generated with two tools mounted on the front slide which also carries the adjustable boring tool holder and tool. Both ends are faced to length and the inside face chamfered with three tools mounted on the automatic back facing attachment. Line drawing shows work locator which is automatically shifted to locating position when machine stops and automatically relieves when machine is started. Operation is entirely automatic. Operator simply loads and unloads chuck and pushes starting lever. Machining time is 39 seconds, floor to floor.

Engineered jobs are our specialty. Our staff is at your disposal to assist in solving your problems.

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POWER SAVING IS IN THE PACKAGE, TOO!

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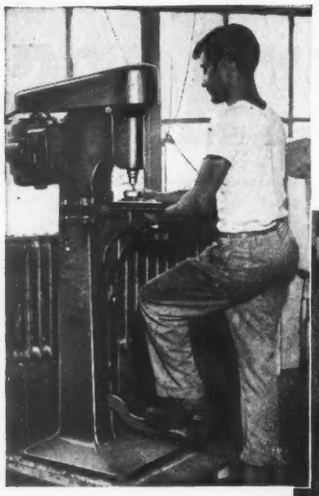

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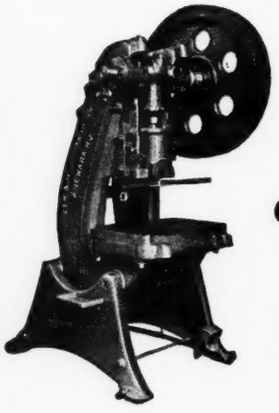

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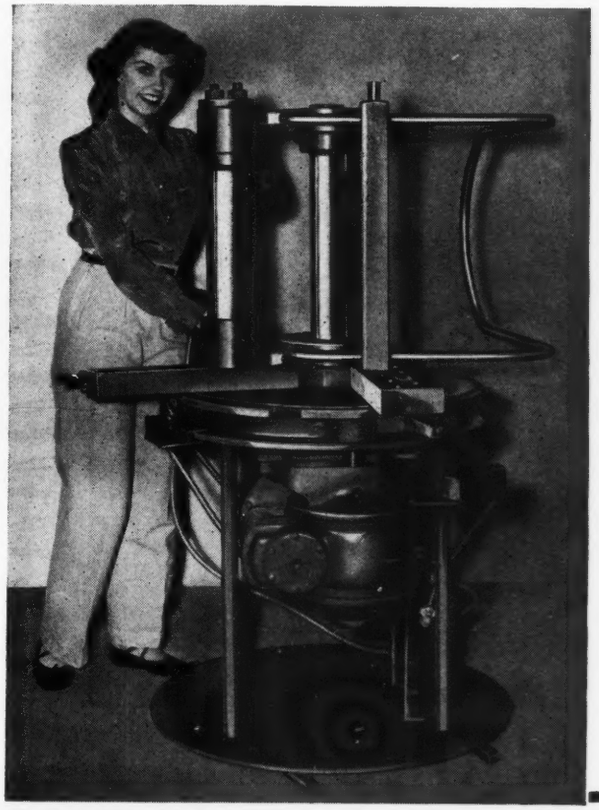

In order to be efficient, a bending machine must do as many things simultaneously as possible. It must be operatable by unskilled labor, and must have a low first cost. It must be relay-controlled, so as to eliminate the human equation.

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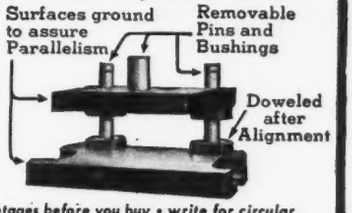

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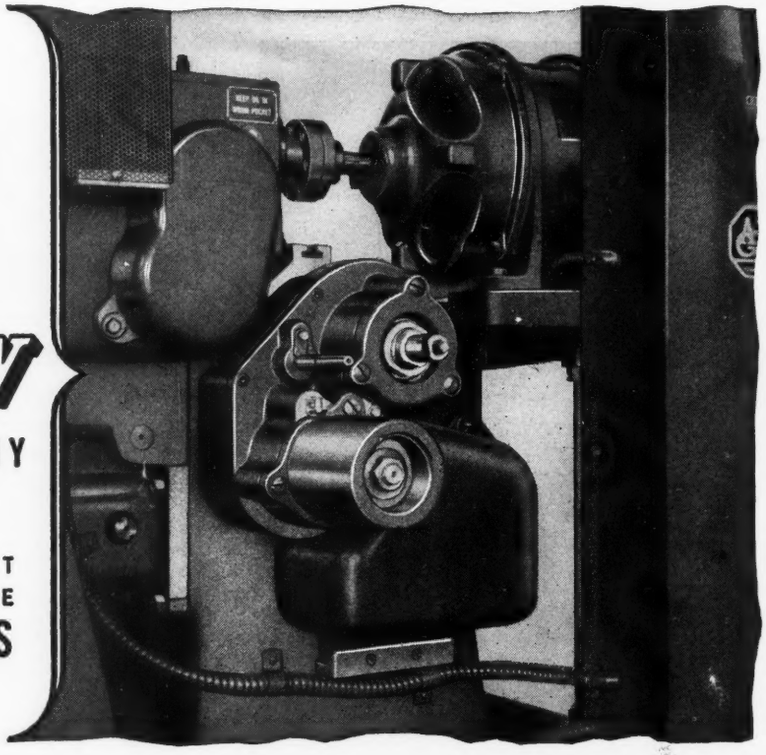
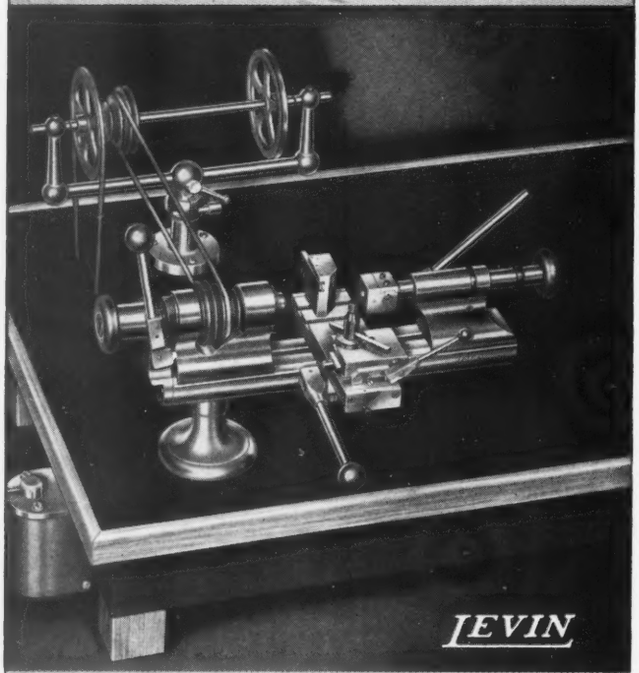


PRECISION LATHES FOR SMALL WORK



Ideal for second operations on instrument parts or other small pieces. 4" swing—collet capacity 5/16" or 3/16". Send for Bulletin "F" containing a complete description of lathes and accessories.

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Whenever you have turning to do, that is within the range of a Clausing Lathe, you will not adequately shoulder your responsibility if you do not fully investigate the additional features the Clausing has to offer you without taking additional dollars from your equipment account.

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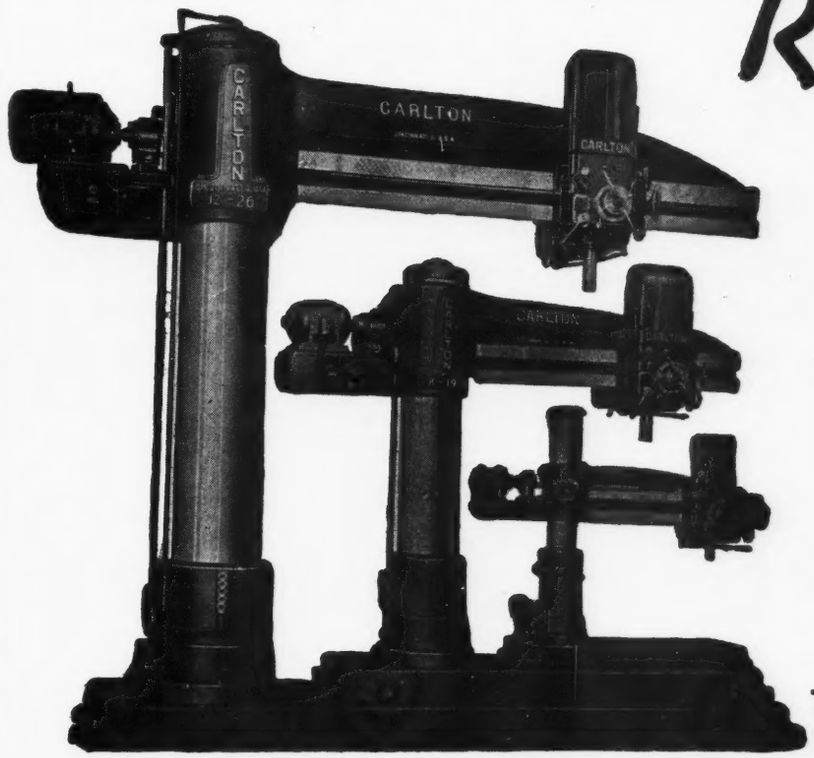

The Carlton Machine Tool Co. offers a complete line of Radial Drilling Machines exclusively, in sizes ranging from 3′ arm to 12′ arm, and from 9″ dia. column to 26″ dia. column. Carlton Radials are delivering outstanding service in almost every large manufacturing plant in the country, as well as railroad shops, shipyards, steel mills, etc. Carlton all-ball-bearing construction with original low-hung drive to spindle makes operation—even under heavy loads—smooth, vibrationless and chatter-proof. Many other modern features available. For greater production, greater economy and satisfaction . . . investigate Carlton Radials today!

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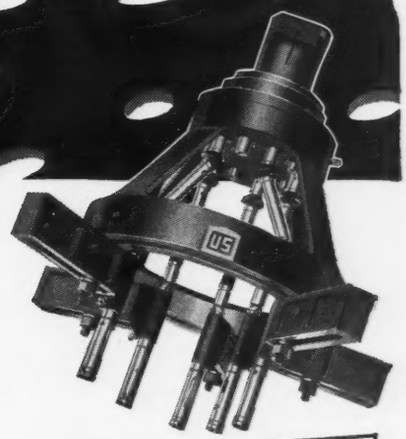
Fit any machine, 2 to 10 Spindles.
Save 2 to 10 Operations.



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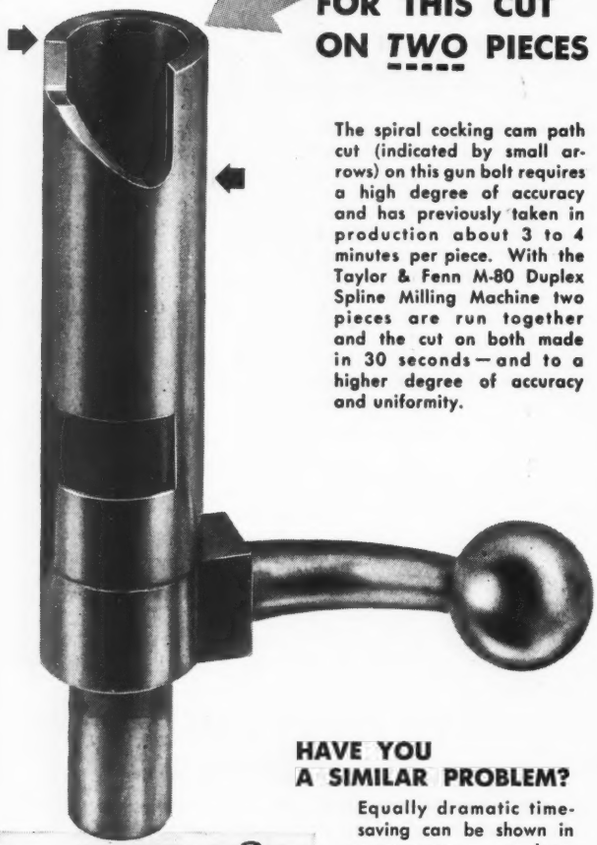
FOR THIS CUT ON *TWO* PIECES



The spiral cocking cam path cut (indicated by small arrows) on this gun bolt requires a high degree of accuracy and has previously taken in production about 3 to 4 minutes per piece. With the Taylor & Fenn M-80 Duplex Spline Milling Machine two pieces are run together and the cut on both made in 30 seconds—and to a higher degree of accuracy and uniformity.

HAVE YOU A SIMILAR PROBLEM?

Equally dramatic time-saving can be shown in many cases . . . perhaps in some phase of your production. We will be glad to discuss the development of a machine specifically designed to meet your requirements.

Above, the fixture and special cam arrangement used in this particular job; to the right, an overall view of the compact, efficient Taylor & Fenn Spline Milling Machine.

EST. TF 1834

THE TAYLOR & FENN CO. Hartford 1, Conn.

Please send me your illustrated bulletin describing the M-80 Spline Milling Machine.

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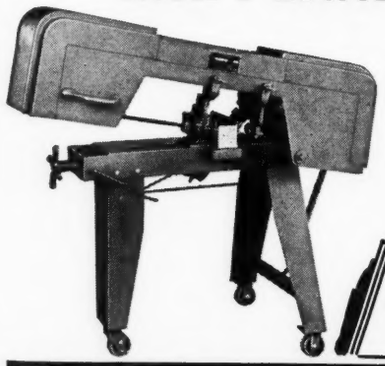

5" x 10" capacity. Inexpensive. Will pay for itself many times over.

ALSO MODEL J, a heavy, sturdy tool. Capacity 10" x 18".

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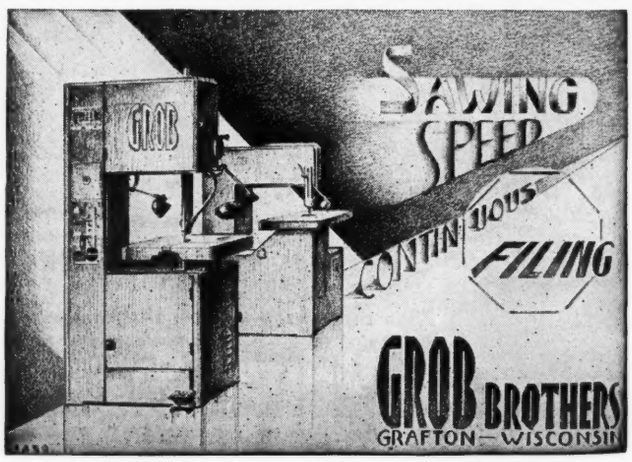
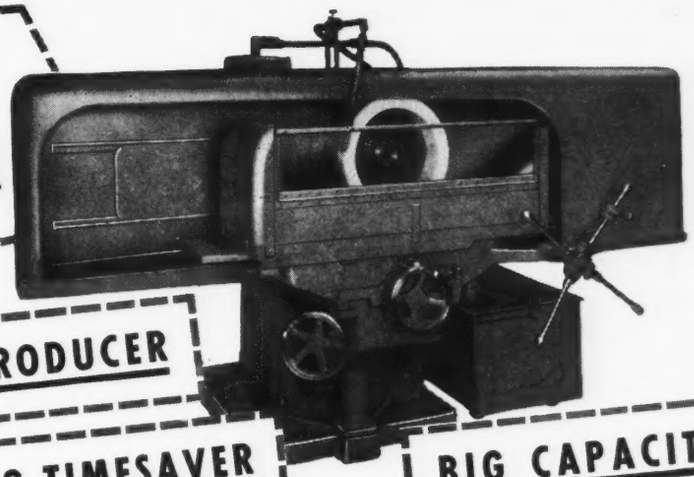


NEW ABRASIVE 18" FACE GRINDER



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Important facts you want to know:

WORK TABLE SURFACE: 13" x 36"

MOTORIZED SPINDLE: Extra-heavy design with pre-loaded ball bearings; built-in 15 h.p. 900 R.P.M. motor

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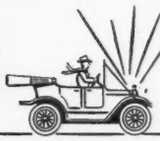
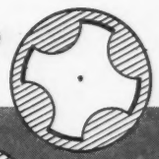
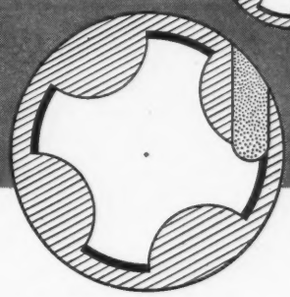
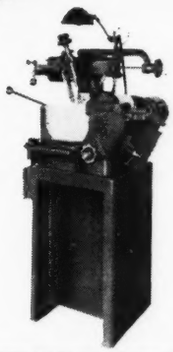






Blake FLUTE GRINDERS



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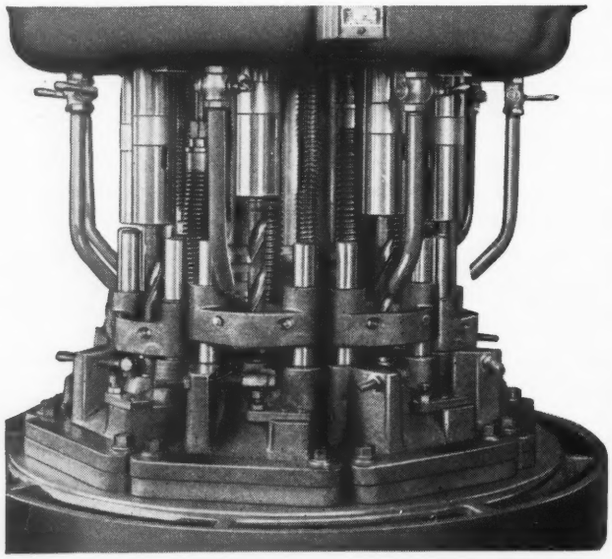
LOWER PRODUCTION COSTS WITH THE

*Roto-Matic**

PRODUCTION METHOD

More production with proper tooling and within minimum floor space is smart processing . . . lowers unit costs. Here's one example of how the Roto-Matic production method helped one manufacturer obtain excellent results . . .



DRILLING 1" DIA. HOLE IN TWO TYPES OF PARTS AT 960 PER HOUR

Two types of bicycle handle bar stems are machined on this Model 8SV vertical drilling machine. The illustration above shows fixture design for holding both types of parts. The hole drilled is 1¼" deep, partially cored, and 1" dia. Parts are drilled at the rate of 960 per hour in a machine with a base only 6 ft. in diameter. Here's why production like this is possible:

The Roto-Matic Drilling Machine is not an indexing type machine. The drills and work rotate continuously while the operator loads and unloads as the work passes the loading station. Feed to the spindles is obtained through an adjustable cam. The machine can be furnished in both vertical and horizontal models and in addition to drilling, the Roto-Matic principle can be applied to milling, reaming, chamfering, spinning, counterboring, spot-facing, balancing correction drilling and similar operations. Investigate the application of this machine or a similar machine to your work today.

WRITE FOR COMPLETE FACTS . . . .

Whether you have high or moderate production requirements in similar operations, write for complete data on D & T Roto-Matics. Ask for bulletin 101.

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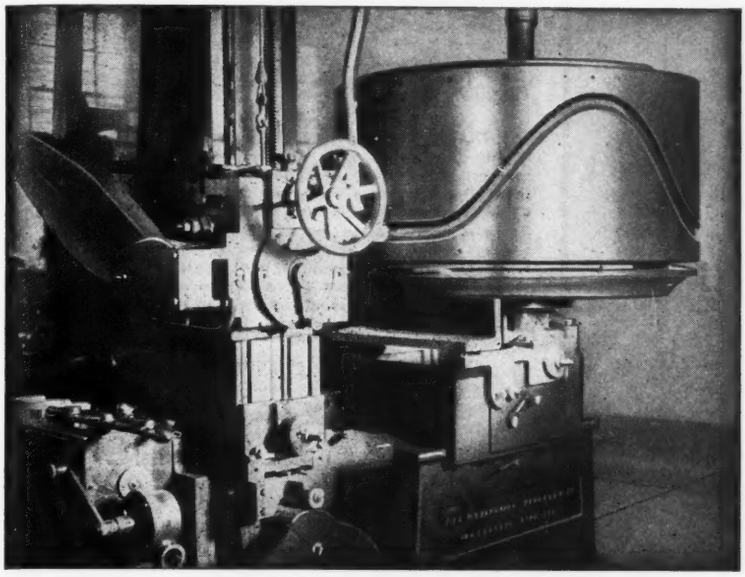

Cast iron barrel cam, 48" outside diameter, 45" inside diameter with a 23½" face. Throw of cam is 17" and groove is 2½" in diameter, milled full depth.

If you are faced with the problem of producing extra large cams – put it up to Rowbottom! Unusual cam-making assignments are everyday routine with us. With our equipment, personnel and experience we can provide you with a speedy solution to every problem of cam use, design and production.

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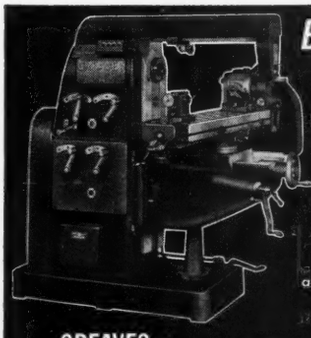

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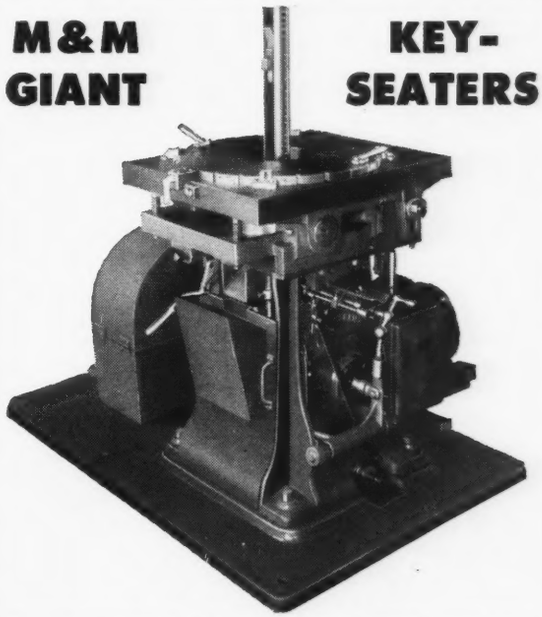
M&M GIANT KEY-SEATERS



Giant Keyseaters, built in various sizes, speedily and accurately cut keyways or splines in pulleys, gears, and other machine parts. Special fixtures and cutters are available for those "hard-to-do" internal finishing operations which cannot be efficiently accomplished otherwise. Send us your problems.

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Discard the out-of-date, slow hand method of driving screws . . . Do it this speedy, time and labor saving way that will boost your production and bring costs down.

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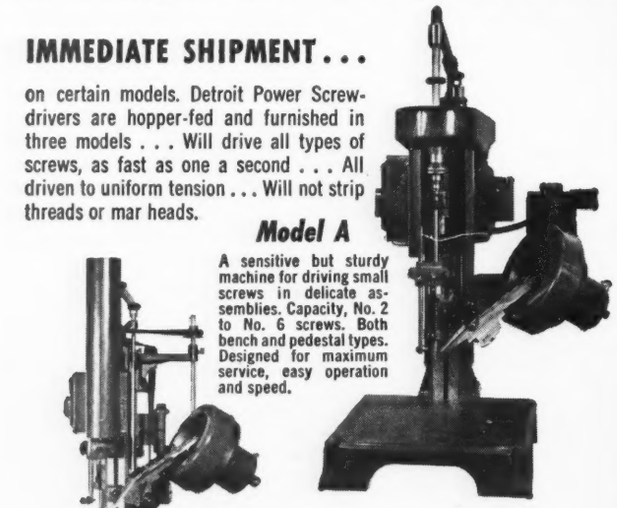
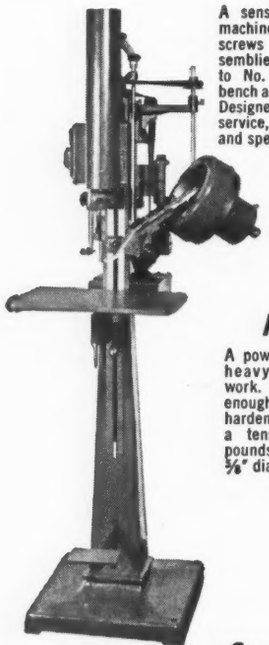


Model A

A sensitive but sturdy machine for driving small screws in delicate assemblies. Capacity, No. 2 to No. 6 screws. Both bench and pedestal types. Designed for maximum service, easy operation and speed.



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A real production machine designed for constant service. It drives a range of screws of all types from No. 6 to ¼" diameter, up to 2" in length. Both bench and pedestal types.

Model C

A powerful machine for heavy-duty assembly work. Every part husky enough to stand driving hardened cap screws to a tension of 50 foot pounds. Capacity, ¼" to ⅜" diameter screws.

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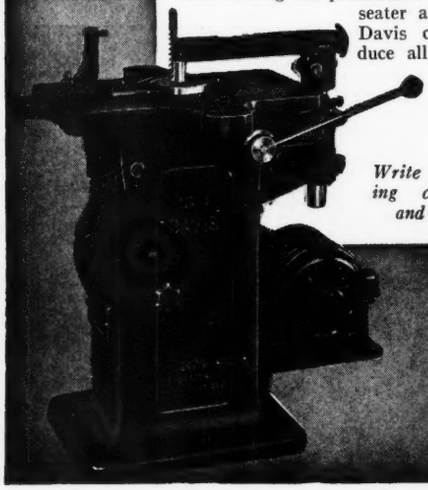

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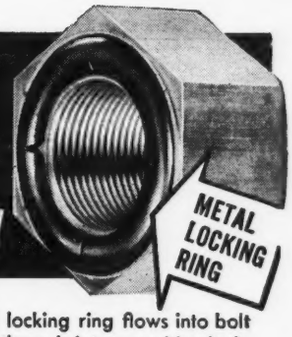
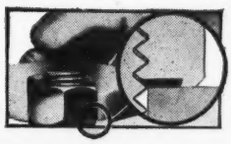
An-cor-lox gives *FULL* locking security



1. When nut is pulled up, metal locking ring flows into bolt threads, wedging the lock nut threads into a positive lock.
2. Once flattened by use, the non-springing locking ring stays deformed, even after backing off. Grip is increased by re-use.
3. Vibration and shock will not walk bolt off—they serve only to force the locking ring farther into the threads.
4. Bolt stretch, wear and moisture do not affect the lock.
5. Up to softening point of the metal, high temperatures do not lessen gripping power.
6. Crushed locking ring prevents passage of gas or liquids.

Available in high, thin, cap or spanner designs

Note wedging action of flattened metal ring



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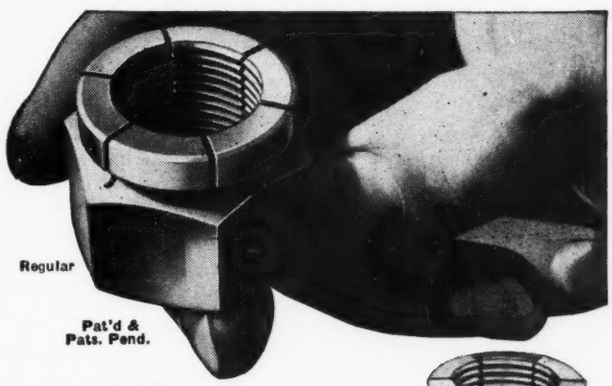
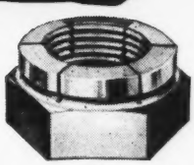
LAMINATED SHIM CO., Inc., *An-cor-lox Division,* **3902 Union St., Glenbrook, Conn.**

AN-COR-LOX NUTS • SHIMS • SHIM STOCK • STAMPINGS





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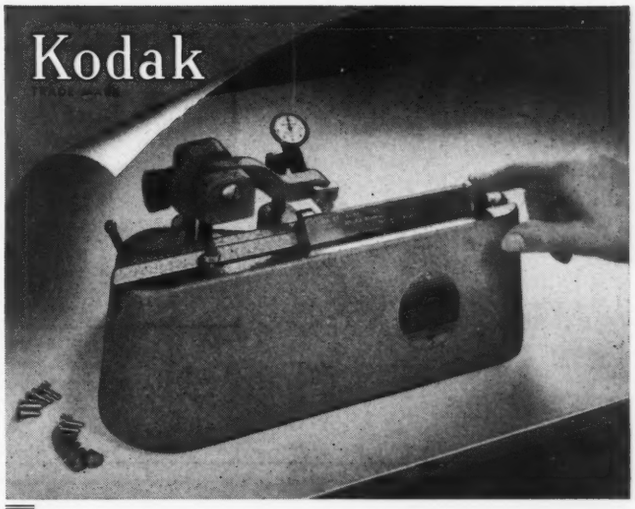

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Test gears in *action*

Test your production gears while revolving . . . test them against the Kodak Conju-Gage Worm Section. For the composite check of gears, it's more accurate, less expensive, and more versatile than a circular master gear for the same test. It's much easier and far faster than older methods using measuring wires.

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For more information on this Kodak Conju-Gage (and other models handling gears up to 8¼-inch pitch diameter) write

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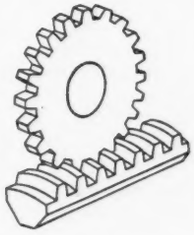

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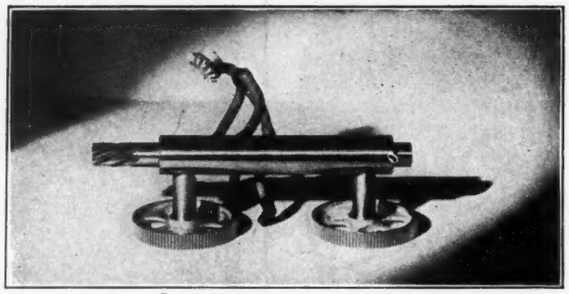

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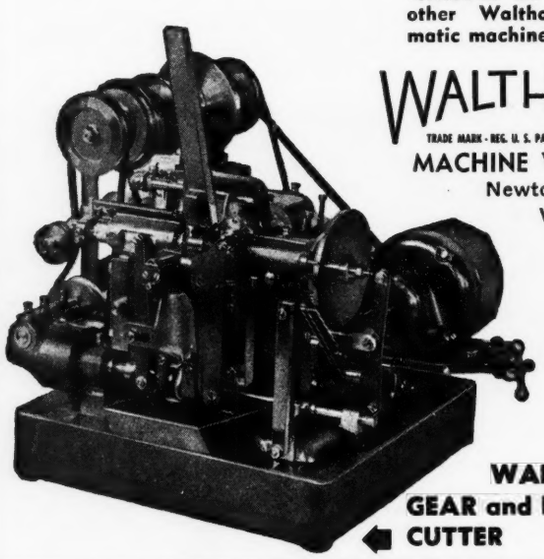

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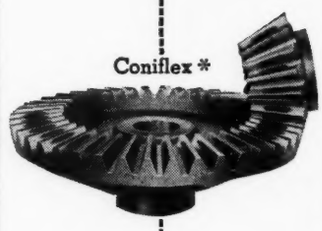

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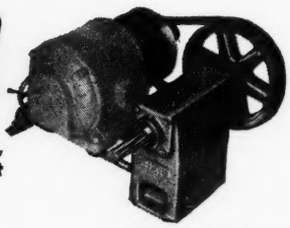

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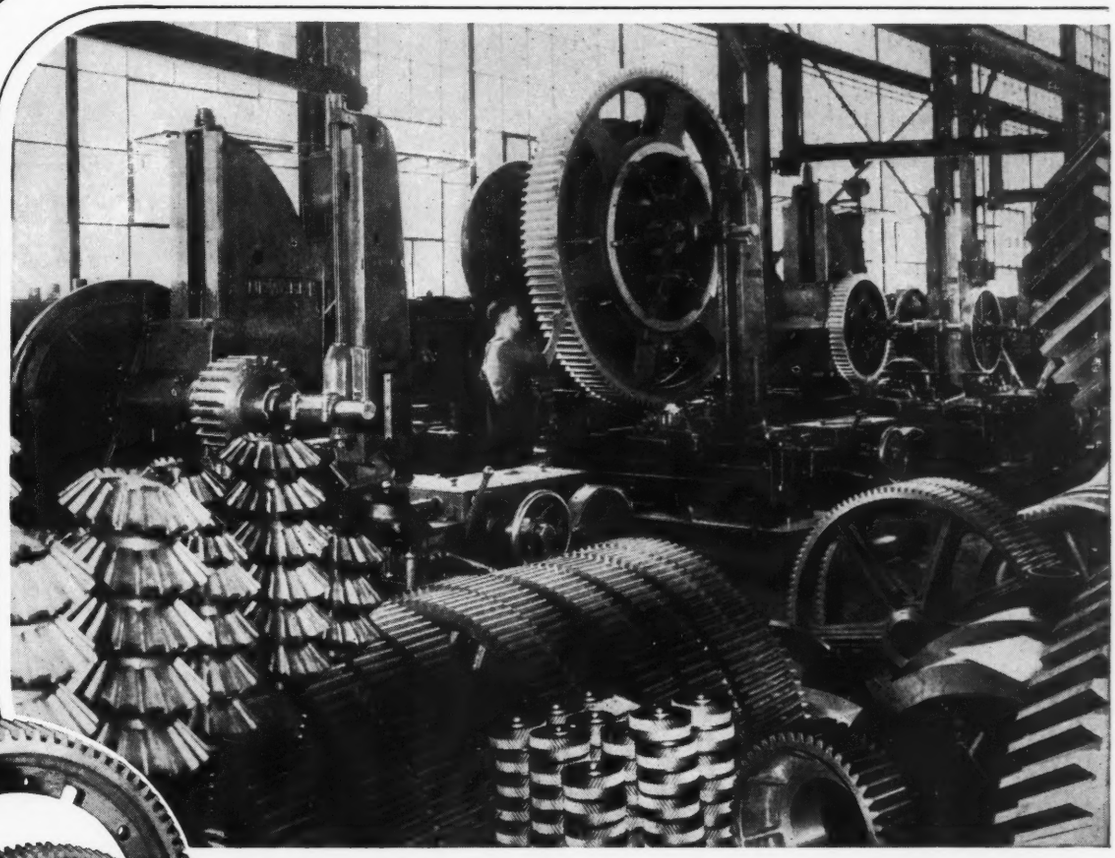

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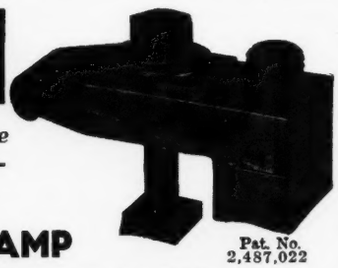

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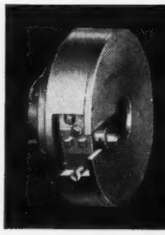

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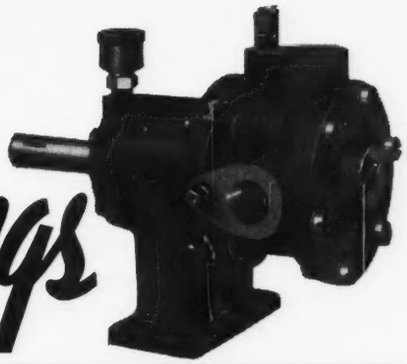

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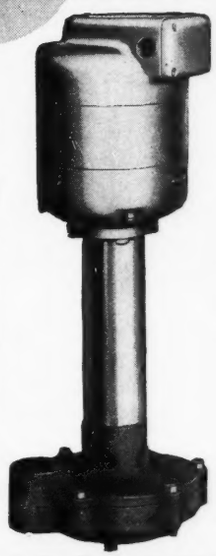

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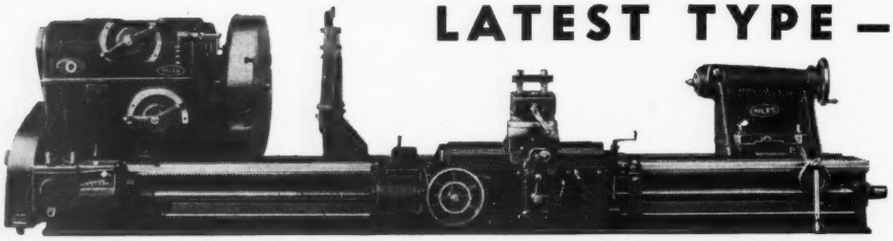

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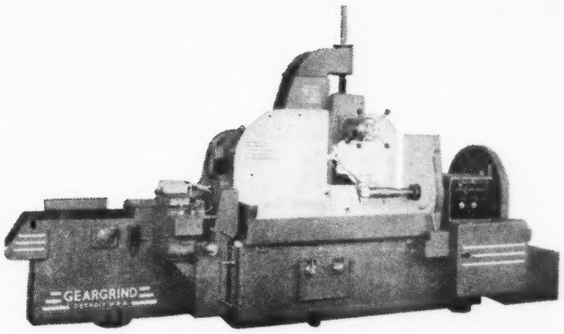

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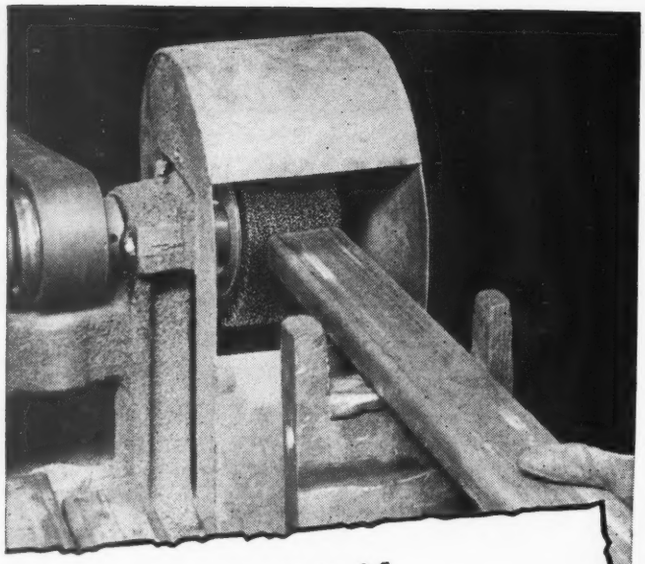

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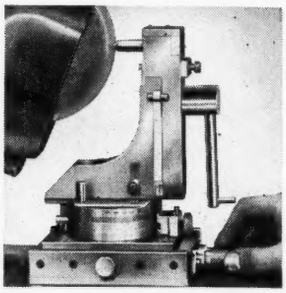

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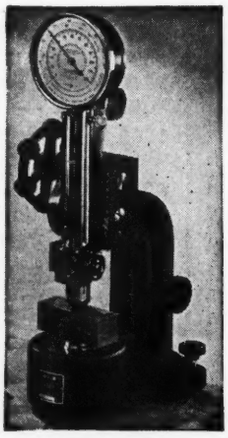

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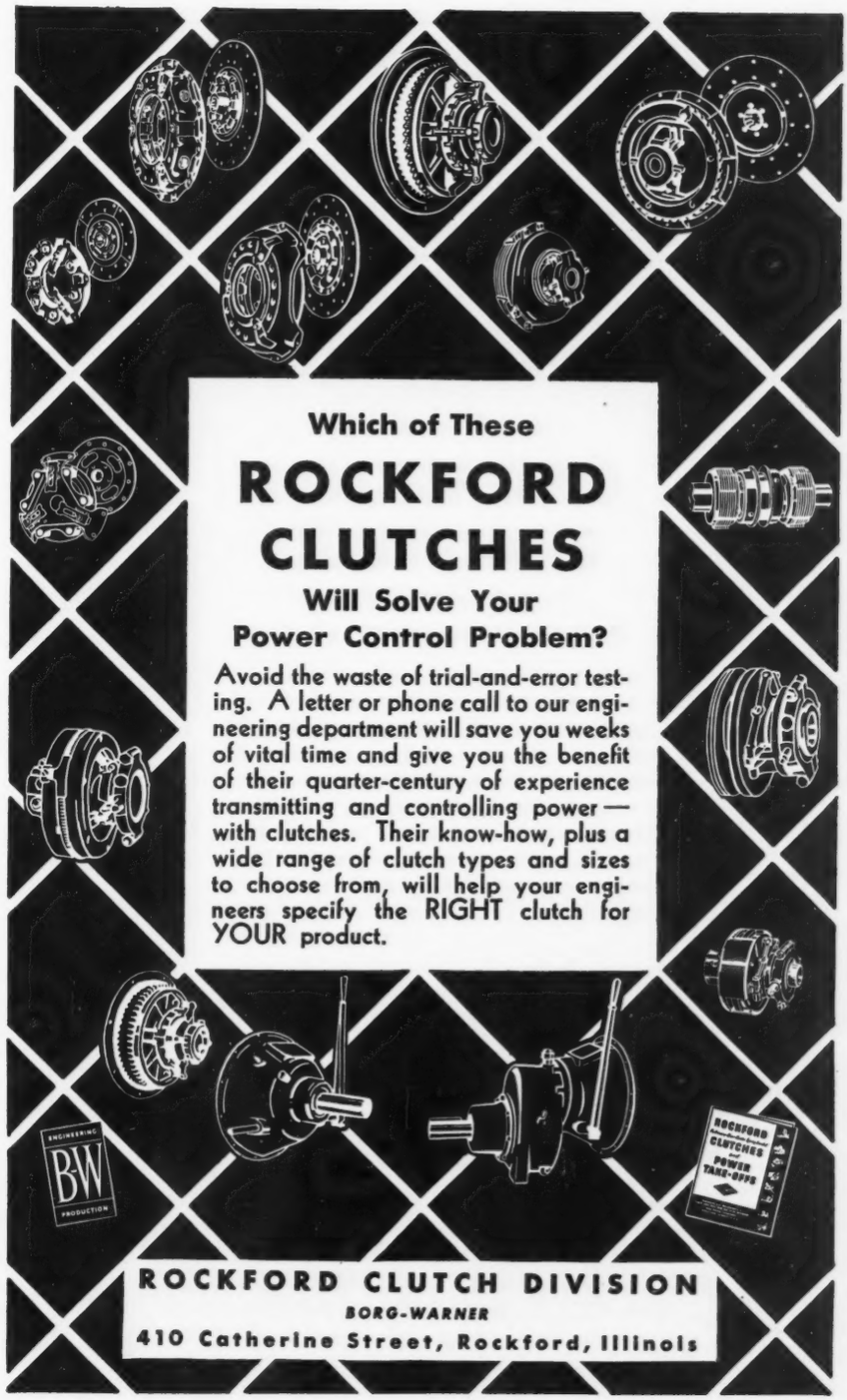
(Continued on page 326)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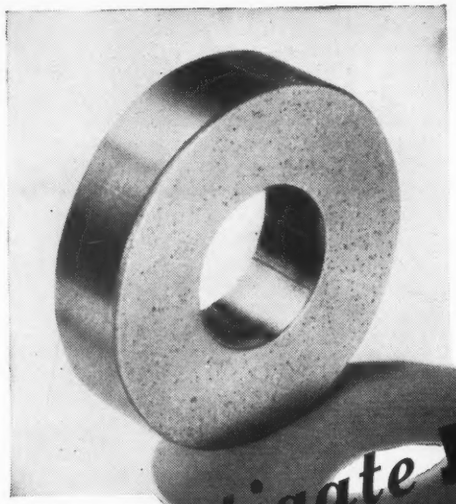


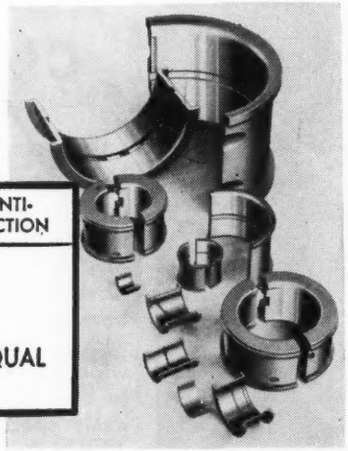
when low cost is important

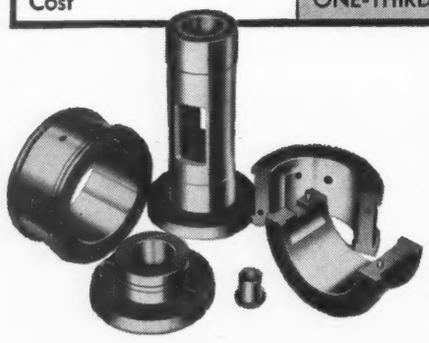
Investigate JOHNSON SLEEVE BEARINGS

YOU may be looking for a means of reducing the cost of parts and assembly time on equipment you manufacture. Here is an example of how Johnson Bronze can help. The sleeve bearing illustrated above was produced to replace an antifriction bearing in an important automotive application. It delivers equal or better performance yet costs *only one-third* as much. Multiply this saving by the thousands of units in which it is installed and you will quickly see the importance of the substitution.

check these important facts

	JOHNSON SLEEVE TYPE	ANTI-FRICTION
Running Friction	LOWER	
Load Carrying Capacity	GREATER	
Resistance to Pounding	GREATER	
Precision	EQUAL	EQUAL
Cost	ONE-THIRD	





SLEEVE BEARINGS by Johnson Bronze are designed by engineers of long practical experience and years of metallurgical and mechanical research. Numerous leading manufacturers consult our specialists before designing or redesigning mechanical equipment. Such firms benefit by high bearing performance and low unit cost. You, too, are invited to write or to consult personally on bearing requirements with these Johnson Bronze Engineers.

Johnson Bronze

SLEEVE BEARING HEADQUARTERS

520 SOUTH MILL STREET • NEW CASTLE, PA.

Co. Div., Tennessee Coal, Iron & R. R. Co. Div.)
Vanadium-Alloys Steel Co.
Wheelock, Lovejoy & Co.

BASES, Machinery, Welded
Mahon, R. C., Co.

BEARINGS, Babbitt
Bunting Brass & Bronze Co.
Johnson Bronze Co.

BEARINGS, Ball
Aetna Ball & Roller Bearing Co.
Ball & Roller Bearing Co.
Fafnir Bearing Co.
Federal Bearings Co., Inc.
Nice Ball Bearing Co.
Norma-Hoffmann Bearings Corp.
S K F Industries, Inc.
Torrington Co.

BEARINGS, Bronze and Special Alloy
Bunting Brass & Bronze Co.
Haynes Stellite Co.
Johnson Bronze Co.

BEARINGS, Lineshaft
Fafnir Bearing Co.
S K F Industries, Inc.
Orange Roller Bearing Co., Inc.
Standard Pressed Steel Co.

BEARINGS, Needle
Norma-Hoffmann Bearings Corp.
Orange Roller Bearing Co., Inc.
Torrington Co.

BEARINGS, Roller
Aetna Ball & Roller Bearing Co.
Fafnir Bearing Co.
Hyatt Bearings Div.,
General Motors Corp.
Norma-Hoffmann Bearings Corp.
Orange Roller Bearing Co., Inc.
S K F Industries, Inc.
Timken Roller Bearing Co.
Torrington Co.

BEARINGS, Self-Lubricating (Oilless)
Arguto Oilless Bearing Co.
Bunting Brass & Bronze Co.
Johnson Bronze Co.
Raybestos-Manhattan, Inc.,
Manhattan Rubber Div.

BEARINGS, Tapered Roller
Timken Roller Bearing Co.
Torrington Co.

BEARINGS, Thrust
Aetna Ball & Roller Bearing Co.
Ball & Roller Bearing Co.
Bunting Brass & Bronze Co.
Fafnir Bearing Co.
General Electric Co.
Norma-Hoffmann Bearings Corp.
Orange Roller Bearing Co., Inc.
Timken Roller Bearing Co.
Torrington Co.

BELT FASTENERS, Metal, Leather, Etc.
Bristol Co.
Raybestos-Manhattan, Inc.
Manhattan Rubber Div.

BELT SHIFTERS
Standard Pressed Steel Co.

BELTING TRANSMISSION
Raybestos-Manhattan, Inc.,
Manhattan Rubber Div.

BENCHES, Work, and Bench Legs
Baumbach, E. A., Mfg. Co.
Standard Pressed Steel Co.

BENDING MACHINES, Angle Iron
Consolidated Mch. Tool Corp.
Hannifin Corp.
Pedrick Tool & Mch. Co.

BENDING MACHINES, Hydraulic
Bethlehem Steel Co.
Buffalo Forge Co.
Chambersburg Engineering Co.
Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Hannifin Corp.
Lake Erie Engineering Corp.
Morgan Engineering Co.
Niagara Machine & Tool Wks.

BENDING MACHINES, Pipe
Buffalo Forge Co.
Farquhar, A. B., Co.
Pedrick Tool & Mch. Co.

BLAST CLEANING EQUIPMENT
Pangborn Corp.
Production Machine Co.
Walls Sales Corp.

BLOWERS
Buffalo Forge Co.
Ingersoll-Rand Co.
Westinghouse Electric Corp.

BOILER TUBES
Ajax Manufacturing Co.
Bethlehem Steel Co.
Republic Steel Corp., Steel & Tubes Div.
Ryerson, Joseph T., & Son, Inc.
U. S. Steel Corp., National Tube Co. Div.

BOLT AND NUT MACHINERY
Ajax Manufacturing Co.
Hill Acme Co.
Landis Mch. Co.
National Machinery Co.
New Britain Machine Co., New Britain-Gridley Mch. Div.

BOLTS AND NUTS
Aluminum Co. of America
Bethlehem Steel Co.
Elastic Stop Nut Corp. of America
National Acme Co.
Ottemiller, W. H., Co.
Republic Steel Corp., Bolt & Nut Div.

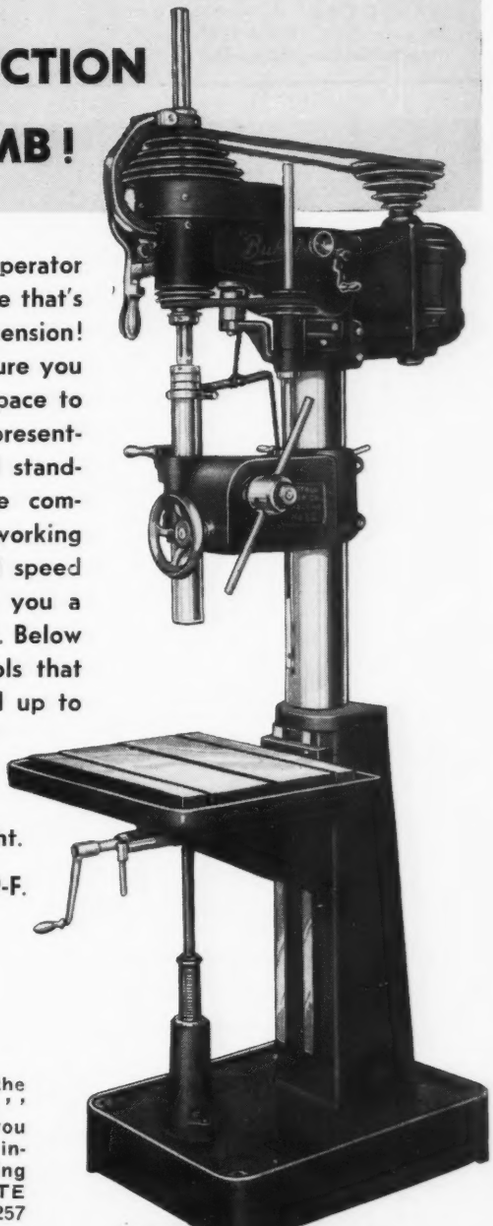
BOOKS, Technical
Industrial Press
Lincoln Electric Co.

BORING AND DRILLING MACHINES
Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Bullard Company
Consolidated Mch. Tool Corp.
Ex-Cell-O Corp.
Foote-Burt Co.
Ingersoll Milling Mch. Co.
Moline Tool Co.
National Acme Co.

BORING AND TURNING MILLS, Vertical
Bullard Company
Cincinnati Planer Co.
King Machine Tool Div., American Steel Foundries

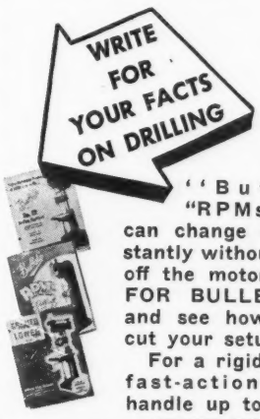
Obsolescent Tools Drain Profits!

REPLACE WITH MODERN "Buffalo" TOOLS AND WATCH PRODUCTION CLIMB!



Even the most experienced operator can't do his best on a machine that's old enough to be retired on pension! So why not check to make sure you aren't giving valuable floor space to any tool that isn't "up" to present-day accuracy and high-speed standards? Replacement from the complete line of "Buffalo" metalworking tools will lend new skill and speed to your operators—and give you a new competitive "profit edge". Below are bulletins on "Buffalo" tools that can do it for you. If you drill up to 2" holes in cast iron, you'll get easy, smooth operation with the big, rugged "Buffalo" No. 22 Drill, shown at right.

WRITE FOR BULLETIN 2989-F.



With the "Buffalo" "RPMster," you can change speeds instantly without shutting off the motor. WRITE FOR BULLETIN 3257 and see how this can cut your setup time.

For a rigid, accurate, fast-action drill to handle up to 7/8" holes in cast iron, WRITE FOR BULLETIN 2730-F, on the No. 16 Sensitive Drill.

BUFFALO FORGE COMPANY
440 Broadway Buffalo, New York
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" METAL WORKING TOOLS

BORING BARS
Armstrong Bros. Tool Co.
Bullard Company
Carboloy Co., Inc.
Everede Tool Co.
Ex-Cell-O Corp.
Gairing Tool Co.
Ingersoll Milling Mch. Co.
Lovejoy Tool Co., Inc.
Pedrick Tool & Mch. Co.
Warner & Swasey Co.

BORING, DRILLING AND MILLING MACHINES, Horizontal
Barnes, W. F. & John, Co.
Ex-Cell-O Corp.
Gray, G. A., Co.
Ingersoll Milling Mch. Co.
Lucas Mch. Tool Div., New Britain Mch. Co.
National Automatic Tool Co.

BORING HEADS
Everede Tool Co.
Ex-Cell-O Corp.
Gairing Tool Co. (Offset)
Ingersoll Milling Mch. Co.
Mummert-Dixon Co.

BORING MACHINES
Ex-Cell-O Corp.
Heald Machine Co.
National Automatic Tool Co.
New Britain Machine Co., New Britain-Gridley Mch. Div.
Stokerunit Corp.

BORING MACHINES, Jig
Bryant Machinery & Engineering Co.
Cincinnati Bickford Tool Co.
Fosdick Mch. Tool Co.
Kearney & Trecker Corp.
Moore Special Tool Co., Inc.
Pratt & Whitney

BORING TOOLS
Armstrong Brothers Tool Co.
Bullard Co.
Carboloy Co., Inc.
Everede Tool Co.
Ex-Cell-O Corp.
Gairing Tool Co.
Haynes Stellite Co.
Kennametal, Inc.
Lovejoy Tool Co., Inc.
Metal Carbides Corp.
Pedrick Tool & Mch. Co.
Super Tool Co.
Union Twist Drill Co.
Warner & Swasey Co.

BRAKES, Press and Bending
Bliss, E. W., Co.
Cincinnati Shaper Co.
Cleveland Crane & Engrg. Co.
Ferracute Machine Co.
O'Neil-Irwin Mfg. Co.
Verson Allsteel Press Co.

BROACHES
American Broach & Mch. Co.
Carboloy Co., Inc.
Colonial Broach Co.
du Mont Corp. (Hand, for keyway cutting)
Ex-Cell-O Corp.
Lapointe Machine Tool Co.
National Broach & Mch. Co.

BROACHING MACHINES
American Broach & Mch. Co.
Cincinnati Milling Mch. Co.
Colonial Broach Co.
Consolidated Mch. Tool Corp.
Foote-Burt Co.
Lapointe Machine Tool Co.
National Broach & Mch. Co.
Oilgear Co.
Wilson, K. R.

BRONZE
American Brass Co.
Bridgeport Brass Co.
Bunting Brass & Bronze Co.
Johnson Bronze Co.

BRUSHES, Industrial
Pittsburgh Plate Glass Co., Brush Div.

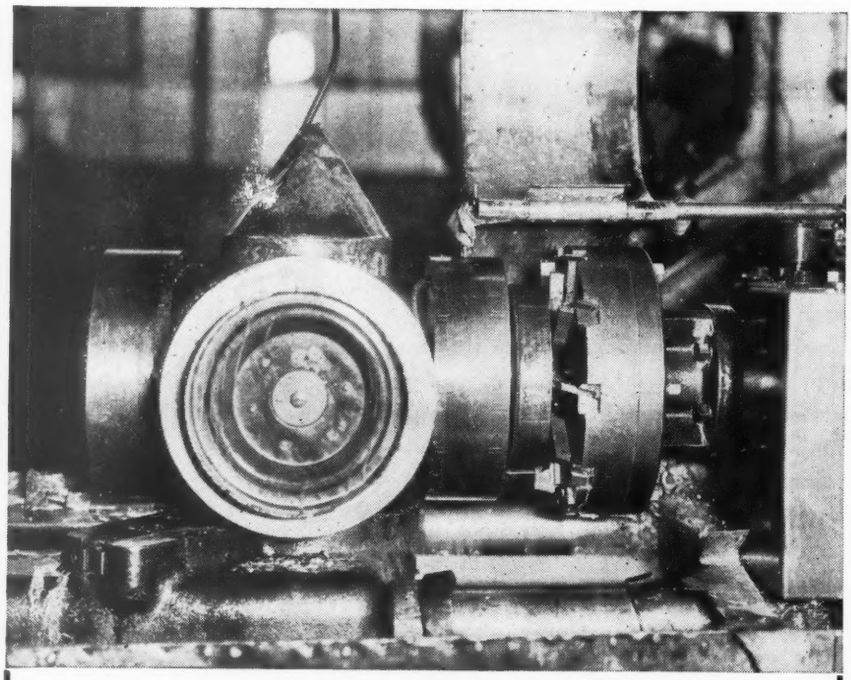
BUFFERS
Cincinnati Electric Tool Co.
Gardner Machine Co.
Power Tool Div., Rockwell Mfg. Co.
U. S. Electrical Motors, Inc.
Van Dorn Electric Tool Co.

BULLDOZERS
Ajax Manufacturing Co.
Chambersburg Engineering Co.
Elmes Engineering Div., American Steel Foundries
Lake Erie Engineering Corp.

BURNISHING MACHINERY
Baird Machine Co.

BURS
See Files and Burs, Rotary

BUSHINGS, Brass, Bronze, Carbide, Etc.
Bunting Brass & Bronze Co.
Haynes Stellite Co.
Johnson Bronze Co.
Kennametal, Inc.



Here are four rugged WALKER magnetic chucks on a Potter & Johnston Turret Lathe performing at a great saving. *Study it.*

WALKER CHUCKS for over a half century have produced *savings* by reducing hand time, worker fatigue, increasing production. WALKER design utilizes the full power of magnetism that has been in existence since the beginning of Time. *There is nothing new about it.* As *the* original designer of Magnetic Chucks, Walker is qualified to engineer your guaranteed savings.

Walker Engineering at your disposal — call Worcester 6-6293

THE ORIGINAL DESIGNERS OF MAGNETIC CHUCKS

O. S. WALKER CO. Inc.
WORCESTER 6, MASSACHUSETTS
Original Designers and Builders of Magnetic Chucks

BUSHINGS, Hardened
Baumbach, E. A., Mfg. Co.
Danly Machine Specialties, Inc.
Leland-Gifford Co.
U. S. Steel Co., Inc.

BUSHINGS, Jig
Colonial Broach Co.
Ex-Cell-O Corp.
Universal Engineering Co.

CABINETS, Tool
Armstrong Brothers Tool Co.

CALIPERS
Ames, B. C., Co. (Dial)
Brown & Sharpe Mfg. Co.
Scherr, George, Co., Inc.
Starrett, The L. S., Co.

CAM CUTTING MACHINES
Fellows Gear Shaper Co.
Pratt & Whitney
Sundstrand Machine Tool Co.

CAM MILLING AND GRINDING MACHINES
Landis Tool Co.
Rowbottom Machine Co.

CAMS
Hartford Special Mchry. Co.
Kux Machine Co.
Rowbottom Machine Co.

CARBIDES, TANTALUM, TITANIUM AND TUNGSTEN
Allegheny Ludlum Steel Corp.
Carboloy Co., Inc.
Kennametal, Inc.
Metal Carbides Corp.
Super Tool Co.
Vanadium-Alloys Steel Co.

CASE-HARDENING FURNACES
See Furnaces, Heat Treating.

CASTINGS, Aluminum, Brass, Bronze, Magnesium, Etc.
Aluminum Co. of America
Bethlehem Steel Co.
(Brass and Bronze only)
Bunting Brass & Bronze Co.

CASTINGS, Die
Aluminum Co. of America
American Brass Co.
Doehler-Jarvis Corp.
Madison-Kipp Corporation
Veeder-Root Inc.

CASTINGS, Iron
Bethlehem Steel Co.
Brown & Sharpe Mfg. Co.
Covel Mfg. Co.
Kingsbury Mch. Tool Corp.

CASTINGS, Steel, Alloys, Etc.
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Birdsboro Steel Fdry. & Mch. Co.
Haynes Stellite Co.
National-Erie Corp.
U. S. Steel Corp., Columbia Steel Co., Div.

CEMENT, Disc Grinding Wheel
Besly, Chas. H., & Co.
Walls Sales Corp.

CENTERING MACHINES
Consolidated Mch. Tool Corp.
Hanson-Whitney Machine Co.
Jones & Lamson Mch. Co.
Murchey Div., Sheffield Corp.
Pratt & Whitney
Seneca Falls Mch. Co.
Sundstrand Machine Tool Co.

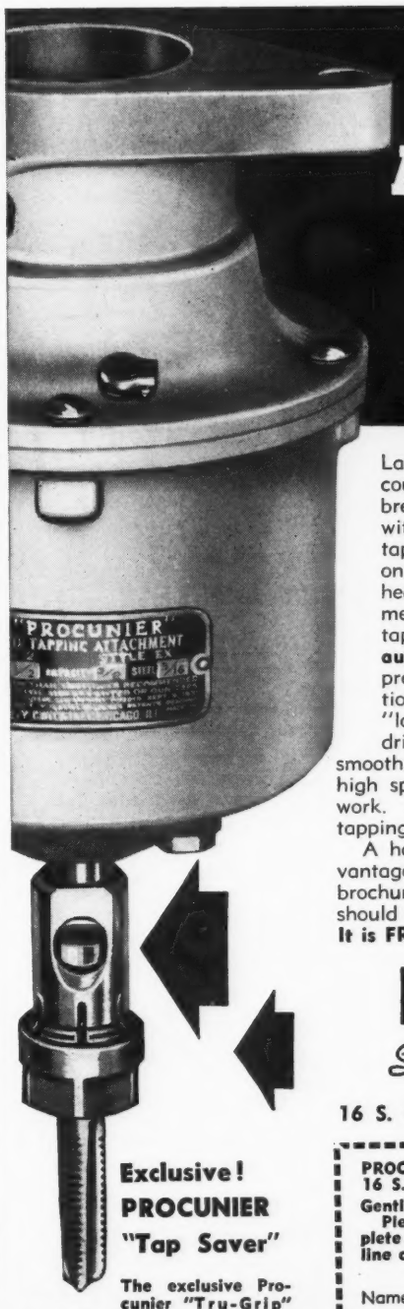
CENTERS, Lathe
Carboloy Co., Inc.
Haynes Stellite Co.
Kennametal, Inc.
Metal Carbides Corp.
Morse Twist Drill & Machine Co.
Standard Tool Co.
Super Tool Co.

CHAINS, Power Transmission and Conveyor
Ohio Gear Co.
Philadelphia Gear Works

CHISEL AND CHISEL BLANKS
Bethlehem Steel Co.
Chicago Pneumatic Tool Co.

CHUCKING MACHINES
Baird Machine Co.
Bardons & Oliver, Inc.
Bullard Company
Gisholt Machine Co.
Goss & DeLeeuw Mch. Co. (Multiple Spindle)
Heald Machine Co.
Herbert, Alfred, Ltd.

(Continued on page 330)



FAST ACCURATE TAPPING at low cost

Large and small companies in every part of the country are reducing labor costs, cutting tap breakage . . . doing faster, more accurate tapping with this improved Procunier cover clamping tap head. The **consistently better performance** on **every job** has made this high speed tapping head preferred by cost-conscious production men. Here is why you can do fast, accurate tapping at low cost: Tap driving pressure is **automatically regulated** by the amount of pressure applied to the unique Procunier friction clutch. Operators quickly detect dull or "loaded" taps just by the pressure needed to drive them. This increased sensitivity and smoothness results in greater tapping accuracy at high speed . . . fewer broken taps, less "spoiled" work. Even unskilled operators can do "blind" tapping as easily as through tapping.

A host of additional Procunier features and advantages are described in detail in an illustrated brochure. It is packed with information that you should have before ordering **any** tapping equipment. **It is FREE . . . mail the coupon today!**

Exclusive! PROCUNIER "Tap Saver"

The exclusive Procunier "Tru-Grip" tap holder is lighter, smaller in diameter. It affords easier tapping close to walls or shoulders, eliminates "chewed" tap shanks. Holds tap true.

Procunier
Safety Chuck Company
16 S. CLINTON ST. • CHICAGO 6, ILLINOIS

PROCUNIER SAFETY CHUCK CO.
16 S. Clinton St., Chicago 6, Illinois
Gentlemen:
Please send your illustrated brochure giving complete details, specifications and prices on the improved line of Procunier High Speed Tapping Heads.

Name.....

Address.....

City.....Zone.....State.....

Jones & Lamson Machine Co.
National Acme Co. (Multiple Spindle)
Potter & Johnston Co.
Sundstrand Mch. Tool Co.
Warner & Swasey Co.

CHUCKS, Air Operated
Cushman Chuck Co.
Gisholt Mch. Co.
Logansport Machine Co., Inc.
Skinner Chuck Co.
Tomkins-Johnson Co.

CHUCKS, Collet or Split
See Collets.

CHUCKS, Diaphragm
Van Norman Co.

CHUCKS, Drill
American Machine & Foundry Co., Wahlstrom Tool Div.
Jacobs Manufacturing Co.
Skinner Chuck Co.
Standard Tool Co.

CHUCKS, Full Floating
Errington Mechanical Laboratory
Gisholt Mch. Co.

CHUCKS, Lathes, Etc.
Bullard Company
Cushman Chuck Co.
Gisholt Mch. Co.
Jacobs Manufacturing Co.
Jones & Lamson Mch. Co.
Scherr, George, Co., Inc.
Skinner Chuck Co.
Warner & Swasey Co.

CHUCKS, Magnetic
Brown & Sharpe Mfg. Co.
Taft-Peirce Mfg. Co.
Walker, O. S., Co., Inc.

CHUCKS, Quick Change and Safety
Errington Mechanical Laboratory
Jarvis, Charles L., Co.
Procunier Safety Chuck Co.

CHUCKS, Ring Wheel
Gardner Machine Co.

CHUCKS, Tapping
Errington Mechanical Laboratory
Jacobs Manufacturing Co.
Procunier Safety Chuck Co.
Skinner Chuck Co.

CIRCUIT BREAKERS
General Electric Co.
Westinghouse Electric Corp.

CLAMPS
Armstrong Brothers Tool Co.
Baumbach, E. A., Mfg. Co.
Brown & Sharpe Mfg. Co.
Danly Machine Specialties, Inc.
La Placa Tool & Die Co.
Standard Shop Equipment Co., Inc.
Starrett, The L. S., Co.

CLEANERS, Chemical, for Metal
Bullard Co., Bullard-Dunn Process Div.
Oakite Products, Inc.

CLUTCHES
Barnes Drill Co.
Clearing Mch. Corp.
Farrel-Birmingham Co., Inc.
Formsprag Co.
Rockford Clutch Div.
Twin Disc Clutch Co.

COLLARS, Safety
Standard Pressed Steel Co.

COLLETS
Brown & Sharpe Mfg. Co.
Gisholt Mch. Co.
Hardinge Brothers, Inc.
New Britain Machine Co., New Britain-Gridley Mch. Div.
Pratt & Whitney
Standard Tool Co.
Tomkins-Johnson Co.
Union Twist Drill Co.
Universal Engineering Co.
Warner & Swasey Co.

COMPARATORS
See Gages, Comparator.

COMPARATORS, Optical
Jones & Lamson Mch. Co.
Scherr, George, Co., Inc.

COMPOUNDS, Cleaning
Oakite Products, Inc.

YOUR CARBIDE CUTTERS DESERVE A BETTER GRIND

Investigate

COVEL

Selective Spindle Rotation

— OUR 76th YEAR —

COVEL Universal Cutter and Tool Grinders were designed with your cutters in mind. Check these features for profitable cutter and tool grinding.

- **Anti-Friction Table**
- **Sealed, Preloaded Ball Bearing Quill Spindle**
- **Convenient Controls from any Working Position**
- **Hardened and Ground Thread Feed Screws**
- **Spindle Lock for Convenient Wheel Changing**
- **Complete Line of Attachments**

The Model No. 22 is available with power table travel and wet attachment.

COVEL'S SELECTIVE SPINDLE ROTATION especially for grinding carbide tools offers rough and finish grinding —without changing wheels or work set-up—maintaining the same direction of grind. This means endless time saved in set-up, mounting diamond wheels, and renewing badly chipped cutters.

WRITE TODAY FOR DETAILED BULLETIN M-20

OUR COMPLETE LINE INCLUDES:
Drill Grinders, Universal Cutter and Tool Grinders, Hydraulic and Hand Feed Surface Grinders

COVEL PRECISION GRINDERS
BENTON HARBOR, MICHIGAN

COMPOUNDS, Cutting, Grinding, Metal Drawing, Etc.
Cities Service Oil Co.
Gulf Oil Corp.
National Broach & Mch. Co. (Broaching and Lapping)
Oakite Products, Inc.
Shell Oil Co.
Standard Oil Co. (Indiana)
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

COMPOUNDS, Resin and Molding
General Electric Co.

COMPRESSORS, Air
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

CONTRACT WORK
Blanchard Mch. Co.
Columbus Die, Tool & Mch. Co.
Diefendorf Gear Corp.
Ex-Cell-O Corp.
Fellows Gear Shaper Co.
Hartford Special Mchry. Co.
Hill Acme Co.
Sheffield Corp.
Merz Engineering Co.
Morse Twist Drill & Machine Co.
Mummert-Dixon Co.
National Acme Co.
Pedrick Tool & Mch. Co.
Rockford Machine Tool Co.
Taft-Peirce Mfg. Co.
U. S. Tool Co., Inc.
Wicaco Machine Corp.

CONTROLLERS
Allen-Bradley Co.
Bristol Co.
General Electric Co.
Westinghouse Electric Corp.

COUNTERBORES
Allen Mfg. Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Continental Tool Works Div.
Ex-Cell-O Corporation
Gairing Tool Co.
Haynes Stellite Co.
Kennametal, Inc.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Starrett, The L. S., Co.
Super Tool Co.
Threadwell Tap & Die Co.
Union Twist Drill Co.

COUNTERSHAFTS
Standard Pressed Steel Co.

COUNTERSINKS
Cleveland Twist Drill Co.
Ex-Cell-O Corp.
Gairing Tool Co.
Greenfield Tap & Die Corp.
Haynes Stellite Co.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Super Tool Co.
Union Twist Drill Co.

COUNTERS, Revolution
Bristol Co.
Brown & Sharpe Mfg. Co.
Starrett, The L. S., Co.
Veeder-Root Inc.

COUNTING DEVICES
Starrett, The L. S., Co.
Veeder-Root Inc.

COUPLINGS, Flexible
Farrel-Birmingham Co., Inc.
Lovejoy Flexible Coupling Co.
Philadelphia Gear Works
Westinghouse Electric Corp.

COUPLINGS, Shaft
Hilliard Corp.
Standard Pressed Steel Co.

CRANES, Electric Traveling
Cleveland Crane & Engrg. Co.
Morgan Engineering Co.
Shepard Niles Crane & Hoist Corp.

CRANES, Hand Traveling
Shepard Niles Crane & Hoist Corp.

CRANES, Locomotive
Cullen-Friestedt Co.

CUTTER GRINDERS
See Grinding Machines, Universal, for Sharpening Cutters, Reamers, Hobs, Etc.

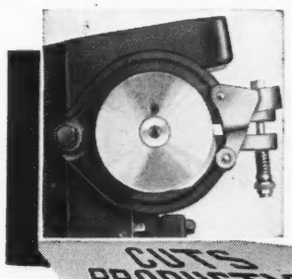
CUTTERS, Gear
Brown & Sharpe Mfg. Co.
Ex-Cell-O Corp.
Fellows Gear Shaper Co.
Morse Twist Drill & Machine Co.
National Broach & Mch. Co. (Shaving)
National Twist Drill & Tool Co.

(Continued on page 332)

AUTOMATIC CAM ACTUATED BRAKE

OF

PRESS-RITE POWER PRESSES



CUTS PRODUCTION COSTS

6 MODELS 5 to 30 ton cap.

STOP... the press automatically at "top center" with a brake that is cam actuated. Braking power is adjusted by the same simple conventional method used in ordinary constant drag brakes and can be instantly set to compensate for various weights of dies used. With cam actuation, constant drag is eliminated and full motor power is utilized to turn out more work at lower cost.

Other cost cutting features of Press-Rite Presses include:

- **Exclusive non-repeat safety mechanism**
- **Triple ramway lubrication**
- **Heavy duty reinforced frame**

See them at your dealer today.

WRITE FOR BULLETIN 250MA

Sales Service Machine Tool Co.

PRESS-RITE PRESSES · SHAPE-RITE SHAPERS · KELLER POWER HACK SAWS

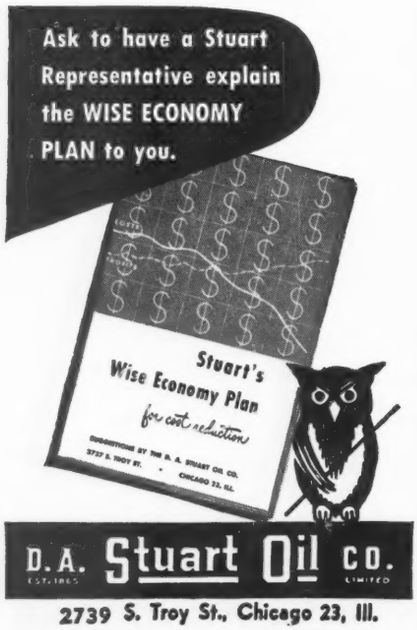
2363 UNIVERSITY AVENUE
ST. PAUL 4, MINNESOTA

REDUCED MACHINING COSTS RESULT FROM WISE SELECTION OF CUTTING FLUIDS

•

STUART'S WISE ECONOMY PLAN provides the method

Not just another spot check "oil survey," the Stuart plan is a scientific appraisal of a plant's over-all needs coupled with *practical* suggestions and followed through with a continuing technical service.



D. A. Stuart Oil Co.

2739 S. Troy St., Chicago 23, Ill.

Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co.
Waltham Machine Works

CUTTERS, Keyseater
Davis Keyseater Co.
du Mont Corp.
Keo Cutters
Threadwell Tap & Die Co.

CUTTERS, Milling
Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Continental Tool Wks., Div., Ex-Cell-O Corp.
Ex-Cell-O Corp.
Gairing Tool Co.
Gorham Tool Co.
Gorton, George, Machine Co.
Hanson-Whitney Mch. Co.
Haynes Stellite Co.
Ingersoll Milling Mch. Co.
Kearney & Trecker Corp.
Kennametal, Inc.
Lovejoy Tool Co., Inc.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Super Tool Co.
Tomkins-Johnson Co.
Union Twist Drill Co.

CUTTING COMPOUNDS
See Compounds, Cutting, Grinding, Etc.

CUTTING AND GRINDING FLUIDS
Cimcool Div., Cincinnati Milling Machine Co.
Cities Service Oil Co.
Gulf Oil Corp.
Shell Oil Co.
Stuart, D. A., Oil Co., Ltd.
Sun Oil Co.
Texas Co.
Tide Water Associated Oil Co.

CUTTING-OFF MACHINES
Bardons & Oliver, Inc.
Bridgeport Safety Emery Wheel Co.
Brown & Sharpe Mfg. Co.
Cone Automatic Mch. Co. (Lathe Type)
Consolidated Mch. Tool Corp.
DoAll Co.
Landis Machine Co. (Pipe)

CUTTING-OFF MACHINES, Abrasive Wheel
Campbell Machine Div., American Chain & Cable
Cincinnati Electric Tool Co.
Covel Mfg. Co.
Power Tool Div., Rockwell Mfg. Co.

CUTTING-OFF MACHINES, Cold Saw
See Sawing Machines, Circular.

CUTTING-OFF MACHINES, Metal Band Saws
Armstrong-Blum Mfg. Co.
Grob Bros.
Johnson Manufacturing Co.

CUTTING-OFF TOOLS
Allegheny Ludlum Steel Corp.
Armstrong Brothers Tool Co.
Haynes Stellite Co.
Kennametal, Inc.
Luers, J. Milton
Pratt & Whitney
Vanadium-Alloys Steel Co.

CUTTING-OFF WHEELS, Abrasive
Carborundum Co.
Norton Co.
Raybestos-Manhattan, Inc., Manhattan Rubber Div.

CYLINDER BORING MACHINES
Baker Brothers, Inc.
Barnes Drill Co.
Consolidated Mch. Tool Corp.
Cross Co.
Ex-Cell-O Corp.
Ingersoll Milling Mch. Co.
Moline Tool Co.

CYLINDERS, Hydraulic
American Hollow Boring Co.
Barnes, John S., Corp.
Hannifin Corp.
Logansport Machine Co., Inc.
Oilgear Co.
Rockford Machine Tool Co.
Tomkins-Johnson Co.

CYLINDERS, Pneumatic
Hannifin Corp.
Skinner Chuck Co.
Tomkins-Johnson Co.

DEALERS, Machinery
Botwinik Brothers of Mass., Inc.
Ecrle Gear & Machine Co.
Motch & Merryweather Mchry. Co.
Ryerson, Joseph T., & Son, Inc.
Simmons Machine Tool Corp.

DEMAGNETIZERS
Blanchard Mch. Co.
Heald Machine Co.
Walker, O. S., Co., Inc.

DESIGNERS, Machine and Tool
Ex-Cell-O Corp.
Hartford Special Mchry. Co.
Pratt & Whitney
Sundstrand Machine Tool Co.

DIE-CASTING MACHINES
Hydropress, Inc.
Kux Machine Co.
Lester-Phoenix, Inc.
Reed-Prentice Corp.

DIE-CASTING
See Castings, Die.

DIE CUSHIONS
Bliss, E. W., Co.
Clearing Mch. Corp.
Dayton Rogers Manufacturing Co.
Verson Allsteel Press Co.

DIE INSERTS, Carbide
Allegheny Ludlum Steel Corp.
Carboloy Co., Inc.
Kennametal, Inc.
Metal Carbides Corp.

DIE MAKERS' SUPPLIES
Allied Products Corp.
Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
Producto Mch. Co.
U. S. Tool Company, Inc.

DIE MAKING MACHINES
Grob Brothers
Kearney & Trecker Corp.
Oliver Instrument Co.

DIE SETS, Standard
Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
Pratt & Whitney
Producto Mch. Co.

DIE SINKING MACHINES
Cincinnati Milling Mch. Co.
Elmes Engineering Div., American Steel Foundries
Pratt & Whitney
Reed-Prentice Corp.

DIE SINKING PRESSES
Kearney & Trecker Corp.

DIE STOCKS
See Stocks, Die.

DIES, Sheet Metal, Etc.
Allied Products Corp.
Baumbach, E. A., Mfg. Co.
Bliss, E. W., Co.
Carboloy Co.
Columbus Die, Tool & Mch. Co.
Everede Tool Co.
Ferracute Machine Co.
Metal Carbides Corp.
Niagara Mch. & Tool Works
Taft-Peirce Mfg. Co.
V&O Press Co., Div. Rockwell Mfg. Co.
Verson Allsteel Press Co.
Wales-Strippit Corp.
Waltham Machine Works

DIES, Threading
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Eastern Mch. Screw Corp.
Geometric Tool Co.
Greenfield Tap & Die Corp.
Hill Acme Co.
Morse Twist Drill & Machine Co.
Murchey Div., Sheffield Corp.
National Acme Co.
Pratt & Whitney
Standard Tool Co.
Threadwell Tap & Die Co.
Winter Bros. Co.

DIES, Threading, Opening
Eastern Mch. Screw Corp.
Errington Mechanical Laboratory
Geometric Tool Co.
Hill Acme Co.
Jones & Lamson Mch. Co.
Landis Mch. Co.
Murchey Div., Sheffield Corp.
National Acme Co.
Sheffield Corp.

DIES, Thread Rolling
Pratt & Whitney

DISCS, Abrasive
Besly, Chas. H., & Co.
Carborundum Co.
Gardner Machine Co.
Norton Co.
Raybestos-Manhattan, Inc. Manhattan Rubber Div.
Simonds Abrasive Co.
Walls Sales Corp.

DIVIDING HEADS
See Index Centers.

DOWEL PINS
Allen Mfg. Co.
Baumbach, E. A., Mfg. Co.
Danly Mch. Specialties, Inc.
Producto Mch. Co.
U. S. Tool Co., Inc.

DRAFTING MACHINES
Universal Drafting Machine Co.

DRESSERS, Grinding Wheel
Carboloy Co., Inc.
J & S Tool Co.
Metal Carbides Corp.
Moore Special Tool Co., Inc.
Norton Co.
Standard Tool Co.
Super Tool Co.

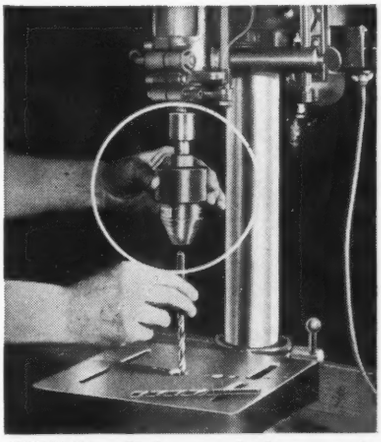
DRIFTS, Drill
Armstrong Bros. Tool Co.
Commander Mfg. Co.
Standard Tool Co.

DRILL HEADS, Multiple Spindle
Baker Brothers, Inc.
Barnes Drill Co.
Buffalo Forge Co.
Errington Mechanical Laboratory
Ex-Cell-O Corp.
Moline Tool Co.
Power Tool Div., Rockwell Mfg. Co.
Root, B. M., Co.
United States Drill Head Co.

DRILL HEADS, Unit Type
Barnes Drill Co.
Kingsbury Mch. Tool Corp.
Rehnberg-Jacobson Mfg. Co.

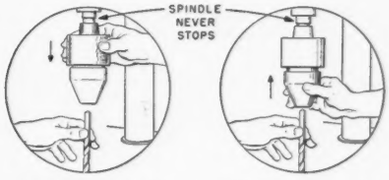
DRILL SOCKETS
Armstrong Bros. Tool Co.
(Continued on page 334)

Change drills in a second, safely with this Automatic Chuck while spindle is running



AMF Wahlstrom Chucks are rugged tools, proven out in many years of heavy production work. Simple construction assures ease of operation.

HERE'S ALL THERE IS TO CHANGING DRILLS



1. Grip sleeve—pull down—jaws open automatically—drill is released.

2. Insert new drill—push up tapered part—drill is locked in place.

You don't stop the machine to change drills with the AMF WAHLSTROM CHUCK. No keys, collets or wrenches are needed.

That's why Wahlstrom Chucks cut costly minutes in changing tools for drill press work or for spotting, drilling and reaming in boring or milling machines. They'll also save money in lathe work for burring, turning, filing, etc. *One spindle does the work of several.*

Tools last longer, too...smooth, hardened and ground jaws grip tight without chewing into tools. Grip increases with the load.

For fast, uninterrupted production, use the quick-change AMF WAHLSTROM CHUCK. It is the only fully automatic drill chuck which holds the widest range of straight shank tools...Model A—1/32" to 1/2"; Model AA—1/64" to 3/8".

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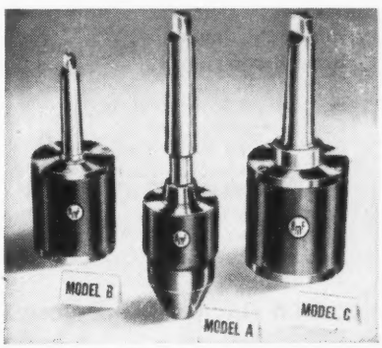
5502 SECOND AVENUE BROOKLYN 20, N. Y.

THESE WAHLSTROM TOOLS CUT COSTS, TOO



Wahlstrom Chucks are available in several size ranges:
Model A—1/32" to 1/2"; Model AA—1/64" to 3/8".
Model B—15/64" to 1/2"; 3/8" to 3/4"; 17/32" to 1".
Model C—Holds any size tool with No. 1, 2, or 3 M. T. Shank

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Pratt & Whitney
Standard Tool Co.
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Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Union Twist Drill Co.
Standard Tool Co.

DRILLING MACHINES, Automatic

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Barnes, W. F. & John, Co.
Baush Machine Tool Co.
Bodine Corp.
Consolidated Mch. Tool Corp.
Hartford Special Machinery Co.
Kingsbury Mch. Tool Corp.
National Automatic Tool Co.
Root, B. M., Co.

DRILLING MACHINES, Bench

Buffalo Forge Co.
Cincinnati Electric Tool Co.
Fosdick Mch. Tool Co.
Leland-Gifford Co.
Power Tool Div., Rockwell Mfg. Co.
South Bend Lathe Works, Inc.
Walker-Turner Div., Kearney & Trecker Corp.

DRILLING MACHINES, Boiler

Cincinnati Bickford Tool Co.
Foote-Burt Co.

DRILLING MACHINES, Deep Hole

Pratt & Whitney
Leland-Gifford Co.
National Automatic Tool Co.

DRILLING MACHINES, Gang

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Baush Machine Tool Co.
Bryant Machinery & Engineering Co
Cincinnati Bickford Tool Co
Consolidated Mch. Tool Corp.
Foote-Burt Co.
Fosdick Mch. Tool Co.
Ingersoll Milling Mch. Co.
Leland-Gifford Co.
Moline Tool Co.
National Automatic Tool Co.
Power Tool Div., Rockwell Mfg. Co.
Root, B. M., Co.

DRILLING MACHINES, Horizontal Duplex

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Barnes Drill Co.
Barnes, W. F. & John, Co.
Baush Machine Tool Co.
Consolidated Mch. Tool Corp.
Davis & Thompson Co.
Kingsbury Mch. Tool Corp.
Moline Tool Co.
Murchey Div., Sheffield Corp.
National Automatic Tool Co.
Sundstrand Mch. Tool Co.

DRILLING MACHINES, HORIZONTAL Portable

Cincinnati Bickford Tool Co.

DRILLING MACHINES, Inverted

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Baush Machine Tool Co.
National Automatic Tool Co.

DRILLING MACHINES, Multiple Center Column Type

Barnes Drill Co.
National Automatic Tool Co.

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Barnes, W. F. & John, Co.
Baush Machine Tool Co.
Bryant Machinery & Engineering Co.
Buffalo Forge Co.
Cincinnati Bickford Tool Co.
Cross Co.
Davis & Thompson Co.
Fosdick Mch. Tool Co.
Greenlee Bros. & Co.
Hartford Special Machinery Co.
Ingersoll Milling Mch. Co.
Kingsbury Mch. Tool Corp.
Leland-Gifford Co.
National Automatic Tool Co.
Moline Tool Co.
Power Tool Div., Rockwell Mfg. Co.
Pratt & Whitney
Root, B. M., Co.
Taylor & Fenn Co.

DRILLING MACHINES, Radial

American Tool Works Co.
Carlton Machine Tool Co.
Cincinnati Bickford Tool Co.
Foote-Burt Co.
Fosdick Mch. Tool Co.

DRILLING MACHINES, Rail

See Drilling Machines, Gang.

DRILLING MACHINES, Sensitive

Buffalo Forge Co.
Foote-Burt Co.
Fosdick Mch. Tool Co.
Leland-Gifford Co.
National Automatic Tool Co.
Power Tool Div., Rockwell Mfg. Co.
Pratt & Whitney
Ryerson, Joseph T., & Son, Inc.
Sibley Mch. & Fdry. Corp.
Taylor & Fenn Co.

DRILLING MACHINES, Upright

Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Baush Machine Tool Co.
Bryant Machinery & Engineering Co.
Buffalo Forge Co.
Cincinnati Bickford Tool Co.
Consolidated Mch. Tool Corp.
Ex-Cell-O Corp.
Foote-Burt Co.
Fosdick Mch. Tool Co.
Hartford Special Machinery Co.
Herbert, Alfred, Ltd.
Ingersoll Milling Mch. Co.
Kingsbury Mch. Tool Corp.
Leland-Gifford Co.
Moline Tool Co.
National Automatic Tool Co.
Power Tool Div., Rockwell Mfg. Co.
Rehnberg-Jacobson Mfg. Co.
Ryerson, Joseph T., & Son, Inc.
Sibley Mch. & Fdry. Corp.

DRILLING MACHINES, Wall Radial

Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.

DRILLS, Center

Cleveland Twist Drill Co.
Gairing Tool Co.
Greenfield Tap & Die Corp.
Keo Cutters
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Standard Tool Co.

Union Twist Drill Co.
Warner & Swasey Co.

DRILLS, Core
Carboloy Co., Inc.
Ex-Cell-O Corp.
Gairing Tool Co.
Haynes Stellite Co.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Super Tool Co.
Union Twist Drill Co.

DRILLS, Deep Hole
Pratt & Whitney

DRILLS, Portable Electric
Chicago Pneumatic Tool Co.
Cincinnati Electric Tool Co.
Precise Products Co.
Ryerson, Joseph T., & Son, Inc.

DRILLS, Portable Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

DRILLS, Ratchet
Armstrong Bros. Tool Co.
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co.

DRILLS, Twist
Ampco Twist Drill Div., Greenfield Tap & Die Corp.
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Mohawk Tool Co.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Super Tool Co.
Union Twist Drill Co.

DRILLS, Wire
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Standard Tool Co.
Union Twist Drill Co.

DUPLICATORS
Pratt & Whitney
Rockford Machine Tool Co.

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ELECTRICAL EQUIPMENT
General Electric Co.
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EMERY WHEELS
See Grinding Wheels.

EMERY WHEEL DRESSERS
See Dressers, Grinding Wheel.

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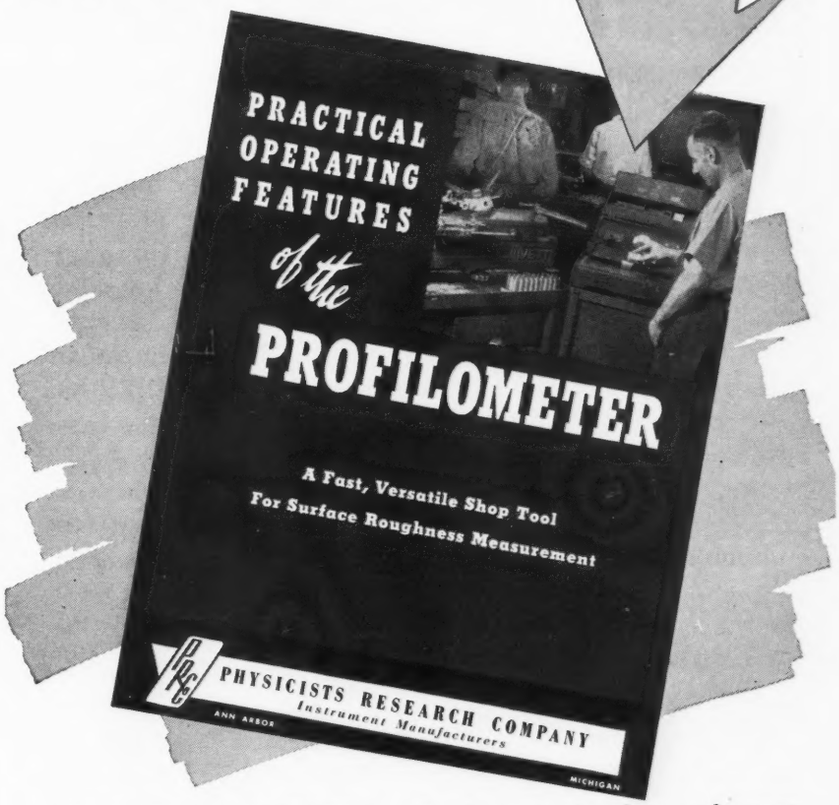
★ ELIMINATE ERRORS

In Measuring Surface Roughness



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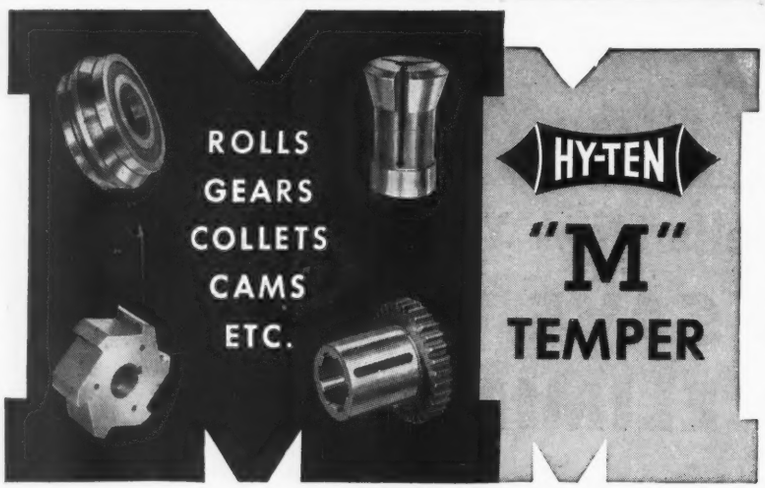

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See Couplings, Flexible.

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FORGINGS, Hollow Bored
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FORGINGS, Iron and Steel
Bethlehem Steel Co.
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Leeds & Northrup Co.

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Leeds & Northrup Co.
Westinghouse Electric Corp.

FURNITURE, Shop
Standard Pressed Steel Co.

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Scherr, George, Co., Inc.
Taft-Peirce Manufacturing Co.
Van Keuren Co.

GAGES, Air
Federal Products Co.
Merz Engineering Co.
Pratt & Whitney
Sheffield Corp.

GAGES, Comparator
Ames, B. C., Co.
Federal Products Corp.
Jones & Lamson Machine Co.
Pratt & Whitney
Scherr, George, Co., Inc.
Sheffield Corp.
Standard Gage Co., Inc.
Taft-Peirce Manufacturing Co.

GAGES, Depth
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Brown & Sharpe Mfg. Co.
Federal Products Corp.
Scherr, George, Co., Inc.
Standard Gage Co., Inc.
Starrett, The L. S., Co.

GAGES, Dial
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Bristol Co.
Brown & Sharpe Mfg. Co.
Federal Products Corp.
Scherr, George, Co., Inc.
Sheffield Corp.
Standard Gage Co., Inc.
Starrett, The L. S., Co.

GAGES, Electric
Federal Products Co.
Merz Engineering Co.
Pratt & Whitney
Sheffield Corp.

GAGES, Height
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Brown & Sharpe Mfg. Co.
Pratt & Whitney
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Merz Engineering Co.
Metal Carbides Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Scherr, George, Co., Inc.
Sheffield Corp.
Standard Gage Co., Inc.
Starrett, The L. S., Co.
Van Keuren Co.

GAGES, Surface

Ames, B. C., Co.
Brown & Sharpe Mfg. Co.
Columbus Die, Tool & Mch. Co.
Starrett, The L. S., Co.

GAGES, Taper

Brown & Sharpe Mfg. Co.
Pratt & Whitney
Sheffield Corp.
Starrett, The L. S., Co.

GAGES, Thread

Axelson Mfg. Co.
Bath, John, Co., Inc.
Federal Products Corp.
Greenfield Tap & Die Corp.
Merz Engineering Co.
Pratt & Whitney
Sheffield Corp.
Taft-Peirce Manufacturing Co.

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Starrett, The L. S., Co.

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Gleason Works

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(Continued on page 341)

WESTINGHOUSE
handles sheets the Easy Way

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C-F Lifters are made in manual or motor models in capacities from 2 to 60 tons or larger, in standard or semi-special designs. Write for the illustrated bulletin "C-F Lifters"—it may help solve a tough materials handling problem for you.

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Carbide tipped cutting tools by GORHAM are custom built to your specifications—the finest quality made. Our engineers are experts in the design, application and manufacture of carbide tipped tools. When you want a "special" tool for a special job, call GORHAM to solve your problem. Our long experience in the field will help you do the job faster, better, more economically. The facilities of our modern plant are at your disposal.

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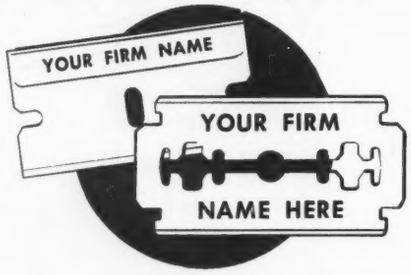

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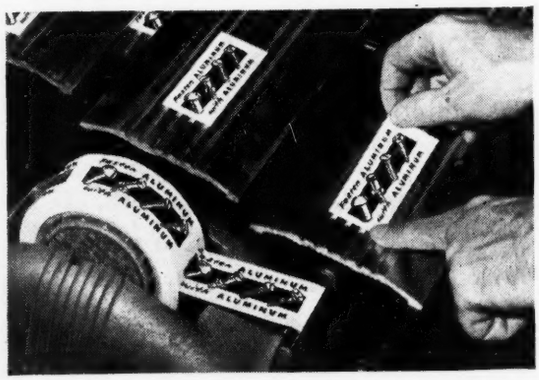

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Fellows Gear Shaper Co.
Gleason Works
National Broach & Machine Co.
Newark Gear Cutting Machine Co.
Scherr, George, Co., Inc.

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Baush Machine Tool Co.
Beaver Gear Works, Inc.
Bilgram Gear & Machine Works
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Cincinnati Gear Co.
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Ohio Gear Co.
Perkins Mch. & Gear Co.
Philadelphia Gear Works
Sier Bath Gear & P ump Co., Inc.
Stahl Gear & Machine Co.
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GEARS, Molded
National-Erie Corp.
Westinghouse Electric Corp.

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Cincinnati Gear Co.
Diefendorf Gear Corp.
Earle Gear & Machine Co.
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Gear Specialties
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Massachusetts Gear & Tool Co.
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Stahl Gear & Machine Co.
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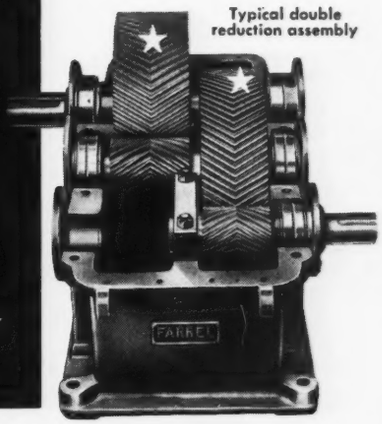
SINGLE AND DOUBLE REDUCTION GEAR UNITS *with a* BACKBONE*



Typical double reduction assembly

Heavy duty single reduction unit

Farrel speed reducers have recently been completely re-engineered, and the line has been expanded to give a wider range of sizes and capacities. Ratios of single reduction units range from 1½:1 to 10:1; double reduction units from 10:1 to 60:1; triple reduction units from 82 to 318.

All of these reducers are equipped with Farrel-Sykes continuous-tooth, herringbone gears—the famous *Gear with a Backbone*—which provide extra strength and high load-carrying capacity. Because they are generated with a high degree of precision, these gears are extremely quiet in operation and give many years of trouble-free service.

For the full story of the many features of Farrel speed reducers, send for a copy of new Bulletin 449.

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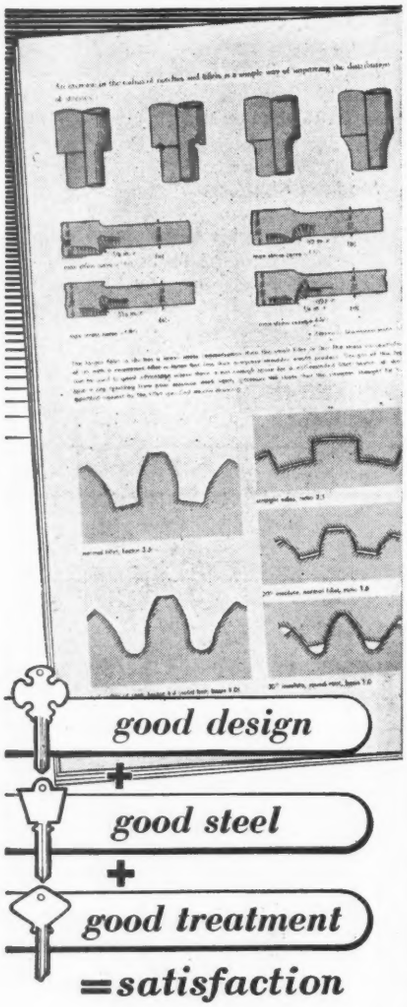

If you are a design engineer seeking success with steel components, you will find help towards your goal on every page of this 72 page booklet. Write now for "3 Keys to Satisfaction"—it is valuable and it is free.

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Walker-Turner Div., Kearney & Trecker Corp.

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Norton Co.

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Oliver Instrument Co.

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GRINDING MACHINES, Chucking
Landis Tool Co.

GRINDING MACHINES, Crankshaft
Landis Tool Co.
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Landis Machine Co.

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Gardner Machine Co.
Mattison Machine Works

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Oliver Instrument Co.

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See Flexible Shaft Equipment.

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See Gear Grinding Machines.

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Pratt & Whitney

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Jones & Lamson Mch. Co.

GRINDING MACHINES, Thread
Ex-Cell-O Corp.
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Jones & Lamson Mch. Co.
Landis Machine Co. (Centerless)
Landis Tool Co. (Centerless)
(Continued on page 344)

NO MORE HEADACHES IN HYDRAULICS

...thanks to LAPOINTE ENGINEERING

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bring smoother, quieter, cooler operation and eliminate high pressure shock and vibration. An overload safety factor as high as 66% assures ample protection under emergency or other unusual requirements in broaching — such as dull tools, variations in material, or amount of stock removed.

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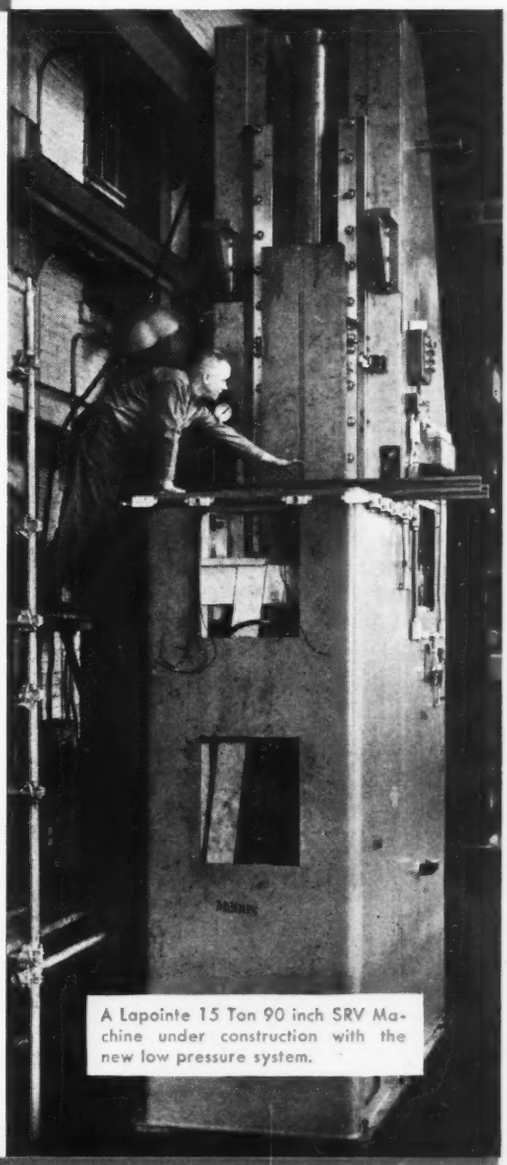

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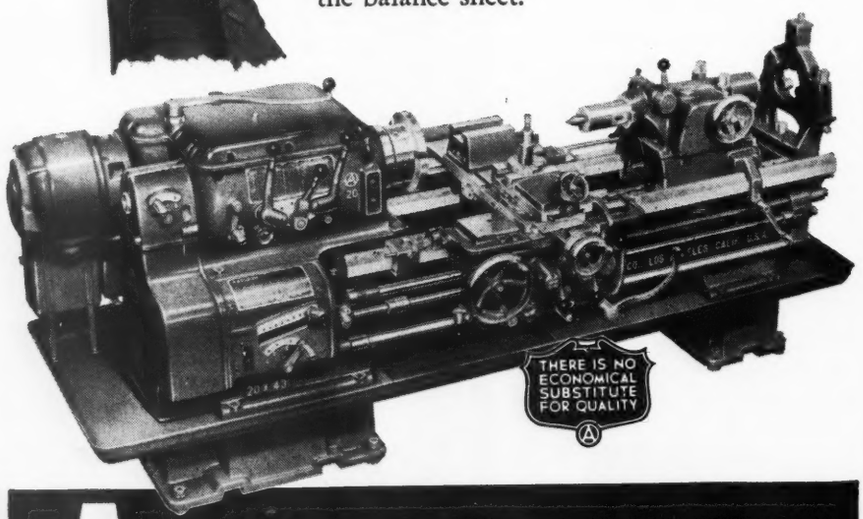

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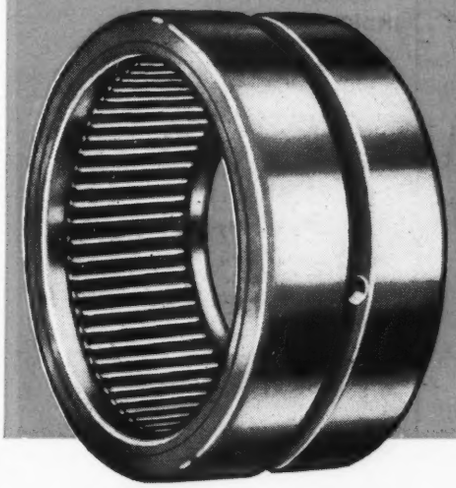

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- Bullard Co.
- Cone Automatic Machine Co., Inc.
- Cross Co.
- Gisholt Mch. Co.
- Goss & DeLeeuw Mch. Co.
- Jones & Lamson Mch. Co.
- LeBlond, R. K., Mch. Tool Co.
- Monarch Mch. Tool Co.
- National Acme Co.
- New Britain Machine Co., New Britain-Gridley Mch. Div.
- Potter & Johnston Co.
- Pratt & Whitney
- Seneca Falls Mch. Co.
- Sundstrand Mch. Tool Co.

LATHES, Axle
- Consolidated Mch. Tool Corp.
- LeBlond, R. K., Mch. Tool Co.
- Seneca Falls Mch. Co.
- Sundstrand Mch. Tool Co.

LATHES, Bench
- Hardinge Brothers, Inc.
- LeBlond, R. K., Mch. Tool Co.
- Levin, Louis, & Son, Inc.
- Pratt & Whitney
- Seneca Falls Mch. Co.
- Sheldon Mch. Co.
- South Bend Lathe Works, Inc.

LATHES, Boring
- Gisholt Mch. Co.
- LeBlond, R. K., Mch. Tool Co.
- Lodge & Shipley Co.

LATHES, Crankshaft
- Consolidated Mch. Tool Corp.
- LeBlond, R. K., Mch. Tool Co.
- Sundstrand Mch. Tool Co.

LATHES, Double-End
- Consolidated Mch. Tool Corp.
- LeBlond, R. K., Mch. Tool Co.
- Sundstrand Mch. Tool Co.

LATHES, Engine and Toolroom
- American Tool Wks. Co.
- Axelson Manufacturing Co.
- Cincinnati Lathe & Tool Co.
- Clausing Manufacturing Co.
- Consolidated Mch. Tool Corp.
- DoAll Co.
- Greaves Machine Tool Co.
- Hendey Machine Co.
- King Machine Tool Div., American Steel Foundries (Sebastian)
- LeBlond, R. K., Mch. Tool Co.
- Lodge & Shipley Co.
- Monarch Mch. Tool Co.
- Morey Mchry. Co., Inc.
- Pratt & Whitney
- Reed-Prentice Corp.
- Rockford Machine Tool Co.
- Seneca Falls Mch. Co.
- Sheldon Mch. Co.
- Simmons Machine Tool Corp.
- South Bend Lathe Works, Inc.
- Springfield Mch. Tool Co.

LATHES, Form Turning
- Monarch Mch. Tool Co.

LATHES, Gap
- Cincinnati Lathe & Tool Co.
- Gisholt Mch. Co.
- King Machine Tool Div., American Steel Foundries (Sebastian)
- LeBlond, R. K., Mch. Tool Co.
- Lodge & Shipley Co.
- Seneca Falls Mch. Co.
- Warner & Swasey Co.

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LeBlond, R. K., Mch. Tool Co.
Seneca Falls Mch. Co.
Springfield Mch. Tool Co.

LATHES, Hollow Spindle
LeBlond, R. K., Mch. Tool Co.

LATHES, Manufacturing Type
Lodge & Shipley Co.

LATHES, Spinning
Bliss, E. W., Co.
Ferracute Machine Co.

LATHES, Toolroom
See Lathes, Engine and Toolroom

LATHES, Turret
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Bullard Company
Gisholt Mch. Co. (Automatic)
Hardinge Brothers, Inc.
(Bench or Cabinet Mounting)
Herbert, Alfred, Ltd.
Jones & Lamson Mch. Co.
King Machine Tool Div., American Steel Foundries (Sebastian)
LeBlond, R. K., Mch. Tool Co.
Lodge & Shipley Co.
Morey Mchry. Co., Inc.
Potter & Johnston Co. (Automatic)
Simmons Machine Tool Corp.
South Bend Lathe Works, Inc.
Springfield Mch. Tool Co.
Warner & Swasey Co.

LATHES, Vertical Turret
Bullard Company
King Machine Tool Div., American Steel Foundries

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Starrett, The L. S., Co.

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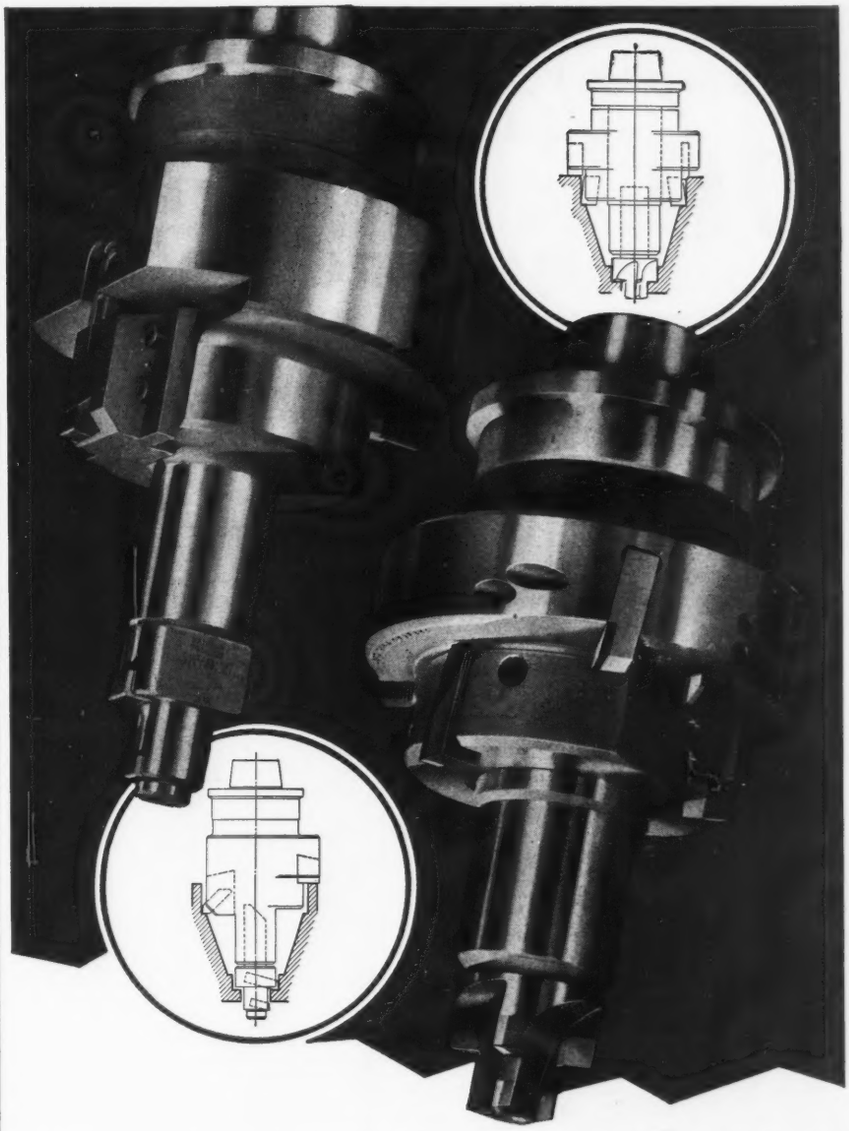

They cut the METAL . . . cut the COSTS

Alarming facts about obsolescence of machine tools have recently been published.

You may or may not be able to replace your obsolete machines. But in either case, remember it's the tools in those machines that cut the metal. They'll cut costs too . . . if efficiently designed. Quite often it's the tooling that makes the difference between profit and loss.

A striking example of how an existing machine was re-tooled for greater productivity is shown here. Designed and built by Gairing, they are two of ten multi-operation tools made to fit a two-way, four-spindle, roughing and precision boring machine making tractor parts.

The success of this well planned tool set-up resulted in an immediate order for more such up-to-the-minute tooling from the same client.

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STANDARD END CUTTING TOOLS
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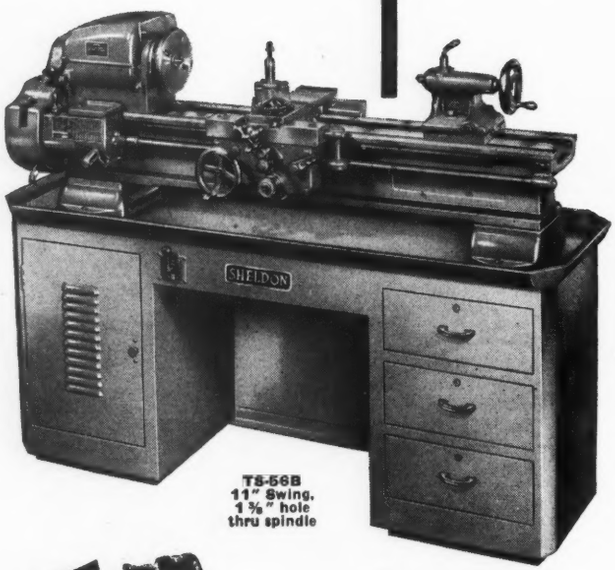
GAIRING TOOLS

66 *variations* of 5 modern machine tools



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1 ⅝" hole
thru spindle

Horizontal
Milling Machine

12" Back Geared
Shaper

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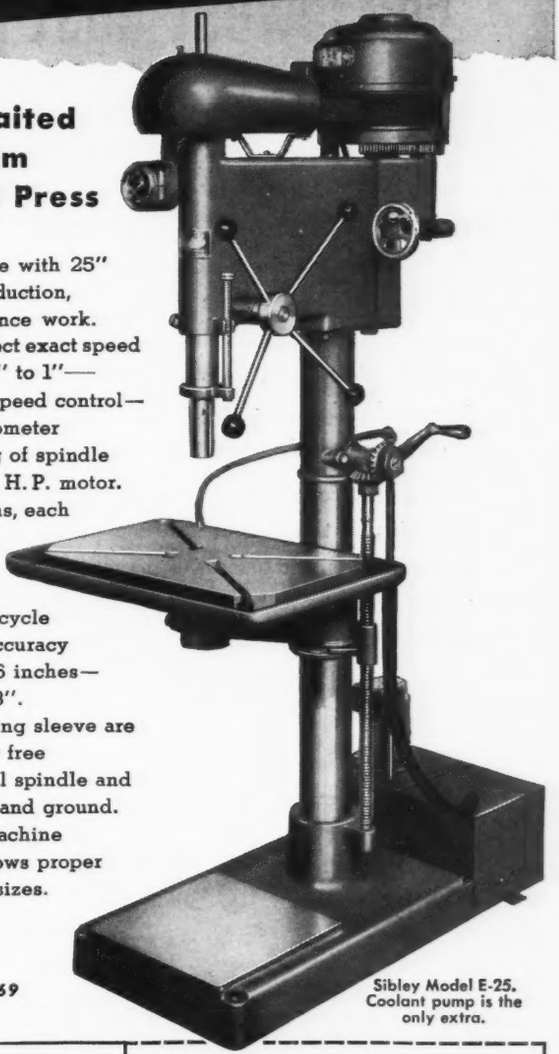

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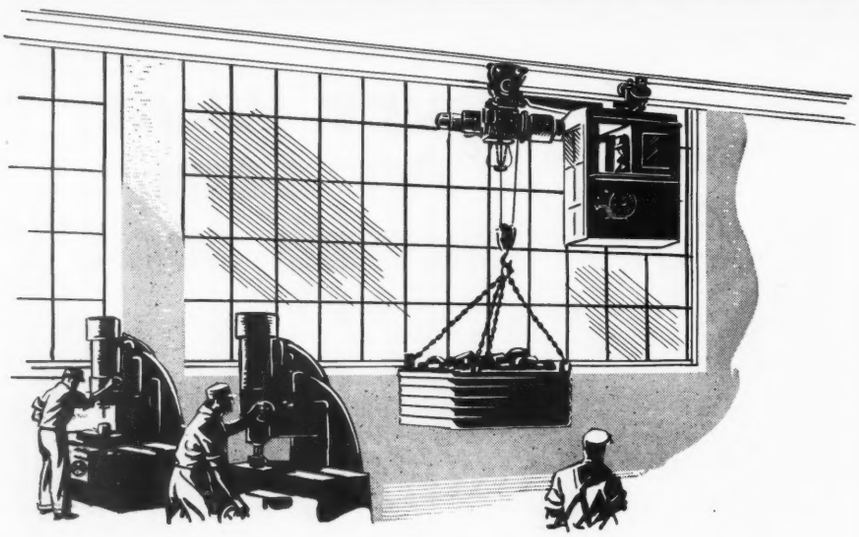

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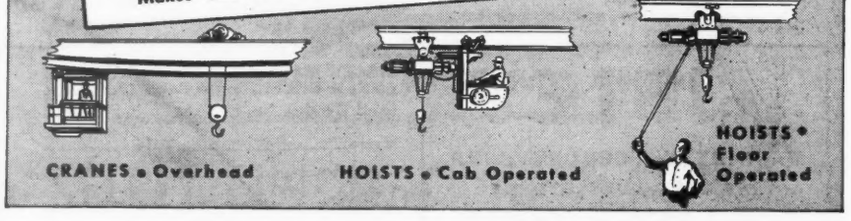

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(Continued on page 352)

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from Unreliable Tooling

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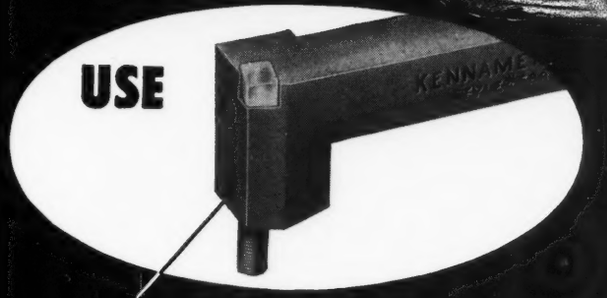

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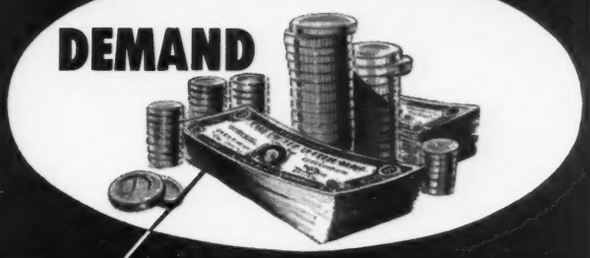

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Unreliable tools—like cheap money—do not give full value, regardless of their price. The loss due to their unsoundness extends far beyond their own cost—lost man hours, excessive machine downtime, wasted materials.

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Elmes Engineering Div., American Steel Foundries
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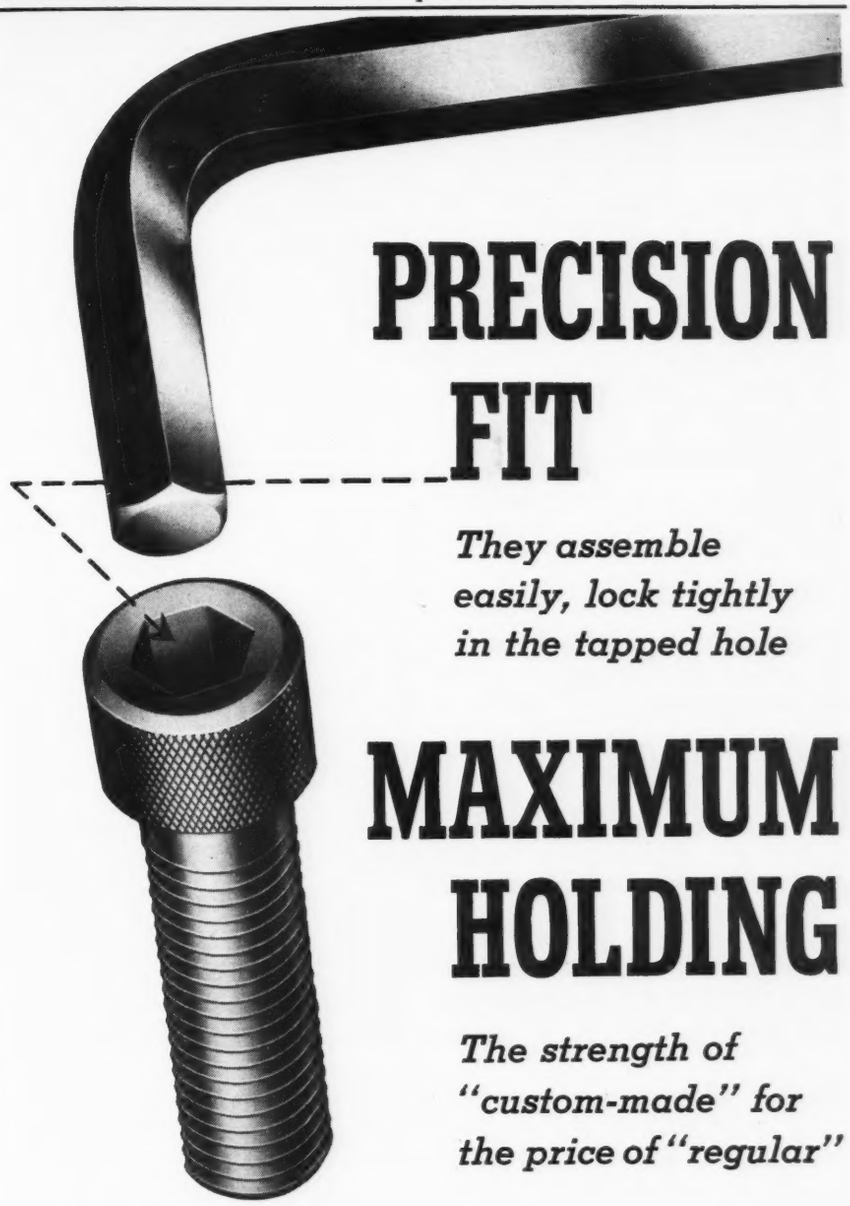

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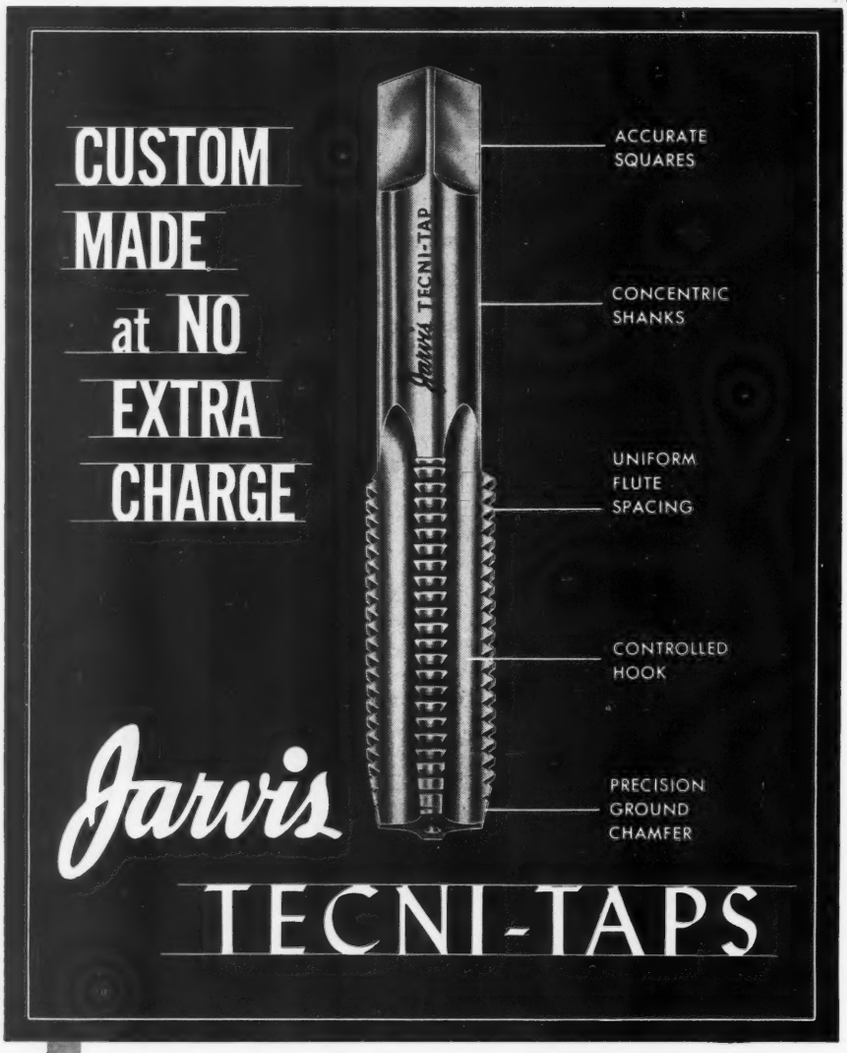

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Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Farrel-Birmingham Co., Inc.
Hannifin Corp.
Hydropress, Inc.
Lake Erie Engineering Corp.
Lapointe Machine Tool Co.
Morgan Engineering Co.
National Erie Corp.
Niagara Machine & Tool Wks.
Oilgear Co.
Verson Allsteel Press Co.
Wilson, K. R.

PRESSES, Screw

Bliss, E. W., Co.
Ferracute Machine Co.
Niagara Machine & Tool Wks.
Zeh & Hahnemann Co.

PRESSES, Sheet Metal Working

Bliss, E. W., Co.
Cincinnati Shaper Co.
Clearing Mch. Co.
Cleveland Crane & Engrg. Co.
Cleveland Punch & Shear Wks. Co.
Consolidated Mch. Tool Corp.
Danly Machine Specialties Co.
Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Ferracute Machine Co.
Hydropress, Inc.
Lake Erie Engineering Corp.
Niagara Machine & Tool Wks.
Sales Service Mch. Tool Co.
Verson Allsteel Press Co.
V & O Press Co., Div. Rockwell Mfg. Co.
Zeh & Hahnemann Co.

PRESSES, Straightening

Anderson Bros. Mfg. Co.
Chambersburg Engineering Co.
Colonial Broach Co.
Consolidated Mch. Tool Corp.
Elmes Engineering Div., American Steel Foundries
Farquhar, A. B., Co.
Hannifin Corp.
Hydropress, Inc.
Morgan Engineering Co.
Niagara Mch. & Tool Wks. (Hydraulic)
Oilgear Co.
Springfield Mch. Tool Co.

PROFILING MACHINES

Consolidated Mch. Tool Corp.
DoAll Co.
Morey Mchry. Co., Inc.
Pratt & Whitney

PROFILOMETER

Physicists Research Co.

PULLEYS

Lovejoy Flexible Coupling Co. (Variable Speed)

PULLEYS, Friction Clutch

Brown & Sharpe Mfg. Co.

PUMPS, Coolant, Lubricant and Oil
Brown & Sharpe Mfg. Co.
Fulflo Specialties Co., Inc.
Ingersoll-Rand Co.
Logansport Machine Co., Inc.
Ruthman Machinery Co.
Tomkins-Johnson Co.
Tuthill Pump Co.
Vickers, Inc.
Viking Pump Co.

PUMPS, Hydraulic
Barnes, John S., Corp.
Bethlehem Steel Co.
Brown & Sharpe Mfg. Co.
Chambersburg Engineering Co.
Denison Engineering Co.
Elmes Engineering Div., American Steel Foundries
Hydropress, Inc.
Ingersoll-Rand Co.
Lapointe Machine Tool Co.
Oilgear Co.
Sundstrand Machine Tool Co.
Tuthill Pump Co.
Vickers, Inc.
Viking Pump Co.

PUMPS, Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

PUMPS, Rotary
Brown & Sharpe Mfg. Co.
Sundstrand Machine Tool Co.
Tuthill Pump Co.
Vickers, Inc.
Viking Pump Co.

PUNCHES AND DIES
See Dies, Sheet Metal, Etc.

PUNCHES, Centering
Cleveland Punch & Shear Works Co.

PUNCHING MACHINERY
Buffalo Forge Co.
Cincinnati Shaper Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Ferracute Machine Co.
Hannifin Corp.
Niagara Machine & Tool Wks.
O'Neil-Irwin Mfg. Co.
Ryerson, Joseph T., & Son, Inc.
Wales-Strippit Corp.
Wiedemann Machine Co.

PYROMETERS
Bristol Co.
Leeds & Northrup Co.

RACKS, Gear Cut
Brown & Sharpe Mfg. Co.
Hartford Special Mchry. Co.
Massachusetts Gear & Tool Co.
Meisel Press Mfg. Co.
Ohio Gear Co.
Philadelphia Gear Works
Stahl Gear & Machine Co.

REAMER HOLDERS
Gairing Tool Co.
Warner & Swasey Co.

REAMERS
Ampco Twist Drill Div., Greenfield Tap & Die Corp.
Barber-Colman Co.
Butterfield Div., Union Twist Drill Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
(Continued on page 356)

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IN ONE
OPERATION
SUBLAND DESIGN
NOW MAKES IT
POSSIBLE
At last it has been done — a tool that combines these two jobs. Mohawks refinement of the subland design means short cuts that have been mechanics dreams-engineers ambitions for years.
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Smaller than the tap and yet larger than root dia. Circle ground its entire length.
TAP
Available in NC and NF threads in standard sizes ¼" to ¾".
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FOLLOW WITH TAP
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CORE DRILL REAM
2 STEP CORE DRILL
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MOHAWK SUBLAND
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Ex-Cell-O Corporation
Gairing Tool Co.
Gorham Tool Co.
Greenfield Tap & Die Corp.
Haynes Stellite Co.
Keo Cutters
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Super Tool Co.
Union Twist Drill Co.

REAMERS, Adjustable

Barber-Colman Co.
Carboloy Co., Inc.
Cleveland Twist Drill Co.
Ex-Cell-O Corporation
Gairing Tool Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Standard Tool Co.
Taft-Peirce Mfg. Co.
Union Twist Drill Co.

REAMERS, Taper Pin

Butterfield Div., Union Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co.

REAMING MACHINES

Greaves Machine Tool Co.
Pratt & Whitney
Van Norman Co.

RECORDING INSTRUMENTS for Counting

National Acme Co.

RECORDING INSTRUMENTS for Electricity

Bristol Co.
General Electric Co.
Leeds & Northrup Co.

RECORDING INSTRUMENTS for Pressure

Bristol Co.
Leeds & Northrup Co.

RECORDING INSTRUMENTS for Speed

Bristol Co.
Leeds & Northrup Co.

RECORDING INSTRUMENTS for Temperature

Bristol Co.
Leeds & Northrup Co.

REELS, Stock, Standard and Automatic

Nilson, A. H., Mch. Co.
U. S. Tool Company, Inc.

REFRACTORIES, Heat Treating Furnace

Norton Co.

REGULATORS, Temperature

Bristol Co.
General Electric Co.
Leeds & Northrup Co.

REMOVERS, Japan, Enamel, Etc.

Oakite Products, Inc.

RETAINING RINGS FOR BEARINGS, ETC.

Nice Ball Bearing Co.
Waldes Kohinoor, Inc.

RHEOSTATS

Allen-Bradley Co.
General Electric Co.
Westinghouse Electric Corp.

RIVET SETS

Bethlehem Steel Co.
Cleveland Punch & Shear Works Co.

RIVETERS, Hydraulic

Bethlehem Steel Co.
Chicago Pneumatic Tool Co.
Hannifin Corp.
Morgan Engineering Co.

RIVETERS, Pneumatic

Chicago Pneumatic Tool Co.
Grant Mfg. Co.
Ingersoll-Rand Co.
Ryerson, Joseph T., & Son, Inc

RIVETING MACHINES

Buffalo Forge Co.
Grant Mfg. & Mch. Co.
Hannifin Corp.
Tomkins-Johnson Co.

RIVET MAKING MACHINES

Hill Acme Co.
National Machinery Co.

RUBBER PRODUCTS

Raybestos-Manhattan, Inc., Manhattan Rubber Div.

RULES, Steel

Brown & Sharpe Mfg. Co.
Scherr, George, Co., Inc.
Starrett, The L. S., Co.

RUST PREVENTIVES

Oakite Products, Inc.
Scherr, George, Co., Inc.

SAND BLAST EQUIPMENT

See Blast Cleaning Equipment.

SANDERS

Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Jarvis, Charles L., Co.
Power Tool Div., Rockwell Mfg. Co.
Sundstrand Machine Tool Co.
Van Dorn Electric Tool Co.

SAW BLADES, Hack

Armstrong-Blum Mfg. Co.
Simonds Saw & Steel Co.
Starrett, The L. S., Co.
Victor Saw Works, Inc.

SAW SHARPENING MACHINES

Covel Mfg. Co.
Earle Gear & Machine Co.
Motch & Merryweather Mchry. Co.
Scherr, George, Co., Inc.

SAWING MACHINES, Circular

Consolidated Machine Tool Corp.
Earle Gear & Machine Co.
Motch & Merryweather Mchry. Co.

SAWING MACHINES, Friction

Ryerson, Joseph T., & Son, Inc.

SAWING MACHINES, Metal Cutting Band

Armstrong-Blum Mfg. Co.
DoAll Co.
Grob Brothers
Power Tool Div., Rockwell Mfg. Co.
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Walker-Turner Div., Kearney & Trecker Corp.

(Continued on page 358)

Card's system of *double* inspection — in the factory and independently, by the Pittsburgh Testing Laboratory — is your *double* assurance of satisfaction when you specify Card Taps... See your nearest Card Distributor for prompt, dependable service.

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The Certified Cutting Tools*

*by the Pittsburgh Testing Laboratory

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Armstrong-Blum Mfg. Co.
Covel Mfg. Co.
Ryerson, Joseph T., & Son, Inc.
Victor Saw Works, Inc.

SAWS, Circular Metal Cutting
Brown & Sharpe Mfg. Co.
Consolidated Mch. Tool Corp.
Motch & Merryweather Mchry. Co.
National Twist Drill & Tool Co.
Simonds Saw & Steel Co.
Standard Tool Co.
Union Twist Drill Co.

SAWS, Metal Cutting Band
Armstrong-Blum Mfg. Co.
DoAll Co.
Johnson Manufacturing Co.
Power Tool Div., Rockwell Mfg. Co.
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Starrett, The L. S., Co.
Walker-Turner Div., Kearney & Trecker Corp.

SAWS, Portable Electric
Van Dorn Electric Tool Co.

SAWS, Screw Slotting
Barber-Colman Co.
Brown & Sharpe Mfg. Co.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Simonds Saw & Steel Co.
Starrett, The L. S., Co.
Union Twist Drill Co.

SCRAPERS, Hand and Power
Anderson Bros. Mfg. Co.

SCREW DRIVERS, Power
Chicago Pneumatic Tool Co.
Detroit Power Screwdriver Co.
Ingersoll-Rand Co.

SCREW DRIVING AND NUT SETTING EQUIPMENT
Cincinnati Electric Tool Co.
Detroit Power Screwdriver Co.
Errington Mechanical Laboratory
Ingersoll-Rand Co.
Jarvis, Charles L., Co.
Van Dorn Electric Tool Co.

SCREW MACHINE TOOLS AND EQUIPMENT
Bardons & Oliver, Inc.
Brown & Sharpe Mfg. Co.
Gisholt Mch. Co.
Greenlee Bros. & Co.
Murchey Div., Sheffield Corp.
National Acme Co.
New Britain Machine Co., New Britain-Gridley Mch. Div.
Potter & Johnston Co.
R and L Tools
Warner & Swasey Co.

SCREW MACHINE WORK
Aluminum Co. of America
Eastern Mch. Screw Corp.
Morse Twist Drill & Machine Co.
National Acme Co.
Ottemiller, W. H., Co.
Standard Pressed Steel Co.
Wicaco Machine Corp.

SCREW MACHINES, Automatic, Single and Multiple Spindle
Brown & Sharpe Mfg. Co.
Cone Automatic Machine Co., Inc.
Greenlee Bros. & Co.
National Acme Co.
New Britain Machine Co., New Britain-Gridley Mch. Div.
Scherr, George, Co., Inc.
Warner & Swasey Co.

SCREW MACHINES, Hand
See also Lathes, Turret.
Bardons & Oliver, Inc.
Brown & Sharpe Mfg. Co.
Gisholt Mch. Co.
Hardinge Brothers, Inc.
Simmons Machine Tool Corp.
Warner & Swasey Co.

SCREW PLATES
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Mch. Co.
Pratt & Whitney
Threadwell Tap & Die Co.
Winter Bros. Co.

SCREWS, Cap, Set, Safety Set and Machine, Etc.
Allen Mfg. Co.
Allied Products Corp.
Bristol Co.
National Acme Co.
Ottemiller, W. H., Co.
Parker-Kalon Corp.
Republic Steel Corp., Bolt & Nut Div.
Standard Pressed Steel Co.

SCREWS, Self-Tapping Drive
Parker-Kalon Corp.

SCREWS, Thumb
American Screw Co.
Parker-Kalon Corp.

SECOND-HAND MACHINERY, ETC.
Botwinik Brothers of Mass., Inc.
Eastern Machinery Co.
Miles Machinery Co.
Morey Machinery Co., Inc.
Simmons Machine Tool Corp.

SEPARATORS, Centrifugal
De Laval Separator Co.

SEPARATORS, Oil or Coolant
Barnes Drill Co. (Magnetic)
National Acme Co.

SHAFTING, Steel
Bethlehem Steel Co.
Cumberland Steel Co.
Republic Steel Corp., Union Drawn Steel Div.
Ryerson, Joseph T., & Son, Inc.

SHAFTS
Standard Pressed Steel Co.

SHAFTS, Flexible
Haskins, R. G., Co.
Jarvis, Charles L., Co.

SHAFTS, Hollow Bored
American Hollow Boring Co.
Bethlehem Steel Co.

SHAFTS, Turned and Ground
Bethlehem Steel Co.
Cumberland Steel Co.
Republic Steel Corp., Union Drawn Steel Div.
Ryerson, Joseph T., & Son, Inc.

SHAPER-PLANERS
Rockford Machine Tool Co.

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Available in two sizes, 6" and 12" throat depth

Now you can punch holes of various shapes as large as 4" diameter in 16 gauge steel—also blank, draw, emboss, form—all with the new DI-ACRO Punch. It is ideal for both experimental and production work.

The precision ground triangular ram of this double purpose press prevents punch head from turning, assuring perfect alignment at all times for accuracy in duplicated parts.

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SHAPERS
American Tool Works Co.
Cincinnati Shaper Co.
Hendey Machine Co.
Rockford Mch. Tool Co.
Sheldon Machine Co.

SHAPERS, Vertical
Pratt & Whitney
Rockford Mch. Tool Co.

SHAPES, Structural
Aluminum Co. of America
Bethlehem Steel Co.
U. S. Steel Corp. (Carnegie-Illinois Steel Corp. Div., Columbia Steel Co., Div., Tennessee Coal, Iron & R. R. Co., Div.)
Van Huffel Tube Corp.

SHEARING MACHINERY
American Pullmax Co., Inc.
Bethlehem Steel Co.
Buffalo Forge Co.
Cincinnati Shaper Co.
Cleveland Crane & Engrg. Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Ferracute Machine Co.
Hannifin Corp.
Hydropress, Inc.
Morgan Engineering Co.
Niagara Mch. & Tool Wks.
O'Neil-Irwin Mfg. Co.
Ryerson, Joseph T., & Son, Inc.
Van Dorn Electric Tool Co. (Portable)
Yoder Co.

SHEARS, Alligator
Hill Acme Co.
Hydropress, Inc.

SHEARS, Rotary
Bliss, E. W., Co.
Brown & Sharpe Mfg. Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Hydropress, Inc.
Niagara Mch. & Tool Wks.
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co. (Knives)
Union Twist Drill Co.

SHEARS, Squaring
Cincinnati Shaper Co.
Cleveland Punch & Shear Works Co.
Consolidated Mch. Tool Corp.
Niagara Mch. & Tool Wks.
Simonds Saw & Steel Co. (Blades)

SHEET METALS
Aluminum Co. of America
American Brass Co.
Bethlehem Steel Co.
Bridgeport Brass Co.
Ingersoll Steel Div., Borg-Warner Corp.
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
U. S. Steel Corp. (Carnegie-Illinois Steel Corp. Div., Columbia Steel Co., Div., Tennessee Coal, Iron & R. R. Co., Div.)

SHEETS, Iron and Steel
Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
U. S. Steel Corp. (Carnegie-Illinois Steel Corp. Div., Columbia Steel Co., Div., Tennessee Coal, Iron & R. R. Co., Div.)

Perforated
Chicago Perforating Co.

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OLIVER ACE CUTTER GRINDERS PAY OFF

HEAVY DUTY MODEL

Oliver Ace Cutter Grinders *pay off* handsomely in any tool room operation.

Cost minded tool buyers have long recognized the efficiency of the Ace Cutter Grinder and know The Ace to be a dependable producer of *accurate* and *finely* finished work.

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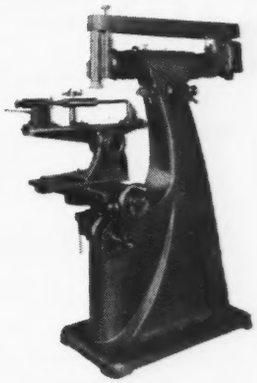

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Greenfield Tap & Die Corp.
Haynes Stellite Co.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co.

SLOTTING MACHINES

Baker Brothers, Inc.
Consolidated Mch. Tool Corp.
Rockford Mch. Tool Co.

SOCKETS

Armstrong Bros. Tool Co.
Cleveland Twist Drill Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
National Twist Drill & Tool Co.
Pratt & Whitney
Standard Tool Co.
Union Twist Drill Co.

SPECIAL MACHINERY AND TOOLS

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Barnes Drill Co.
Barnes, W. F. & John, Co.
Baush Machine Tool Co.
Bethlehem Steel Co.
Bilgram Gear & Mch. Wks.
Birdsboro Steel Fdry. & Mch. Co.
Blanchard Machine Co.
Bliss, E. W., Co.
Chambersburg Engineering Co.
Columbus Die, Tool & Machine Co.
Consolidated Mch. Tool Corp.
Earle Gear & Machine Co.
Elmes Engineering Div., American Steel Foundries
Ex-Cell-O Corp.
Farrel-Birmingham Co., Inc.
Fellows Gear Shaper Co.
Fischer Machine Co.
Gairing Tool Co.
Gisholt Mch. Co.
Grant Mfg. & Mch. Co.
Greenlee Bros. & Co.
Hannifin Corp.
Hartford Special Mchry. Co.
Hill Acme Co.
Hydropress, Inc.
Ingersoll Milling Mch. Co.
Lake Erie Engineering Corp.
Moline Tool Co.
Morgan Engineering Co.
National Acme Co.
National Automatic Tool Co.
National Broach & Mch. Co.
National-Erie Corp.
National Twist Drill & Tool Co.
New Britain Machine Co., New Britain-Gridley Mch. Div.
New Jersey Gear & Mfg. Co.
Niagara Mch. & Tool Wks.
Oilgear Co.
Pedrick Tool & Mch. Co.
Pratt & Whitney
Reed-Prentice Corp.
Seneca Falls Mch. Co.
Sundstrand Mch. Tool Co.
Taft-Peirce Mfg. Co.
Union Twist Drill Co.
V & O Press Co., Div., Rockwell Mfg. Co.
Waltham Machine Works
Wicaco Machine Corp.

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Farrel-Birmingham Co., Inc.
Ganschow Gear Co.
General Electric Co.
Ohio Gear Co.
Philadelphia Gear Works
Shepard Niles Crane & Hoist Corp.
Twin Disc Clutch Co.
U. S. Electrical Motors, Inc.
Westinghouse Electric Corp.

SPINDLES, Grinding

Ex-Cell-O Corporation
Pope Machinery Corp.

SPINDLES, Hollow Bored

American Hollow Boring Co.

SPINNING LATHES

See Chucking Machines.

SPRING COILING AND FORMING MACHINERY

Baird Machine Co.

SPROCKET CHAINS

Ohio Gear Co.
Philadelphia Gear Works

SPROCKETS

Hartford Special Mchry. Co.
Industrial Mch. & Gear Works
National-Erie Corp.
Ohio Gear Co.
Philadelphia Gear Works
Stahl Gear & Mch. Co.

STAMPINGS, Sheet Metal

Aluminum Co. of America
Dayton Rogers Manufacturing Co.
Laminated Shim Co., Inc.
Republic Steel Corp., Niles Steel Products Div.
Revere Copper & Brass Inc.

STAMPS, Steel, and Marking Dies

Noble & Westbrook Mfg. Co.
Numberall Stamp & Tool Co.

STEEL

Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Ingersoll Steel Div., Borg-Warner Corp.
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Timken Roller Bearing Co.
U. S. Steel Corp. (American Steel & Wire Co. Div., Carnegie-Illinois Steel Corp., Div., Columbia Steel Co. Div., Tennessee Coal, Iron & R. R. Co. Div.)
Vanadium-Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

STEEL, Cold Drawn

Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Crucible Steel Co. of America
Republic Steel Corp., Union Drawn Steel Div.
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
U. S. Steel Corp., American Steel & Wire Co. Div.
Vanadium-Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

(Continued on page 362)

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With one *Minute Man* Broach and Bushing, costing only $8.25, you can cut 100 keyways in gears, milling cutters, pulley hubs, collars, couplings, etc.

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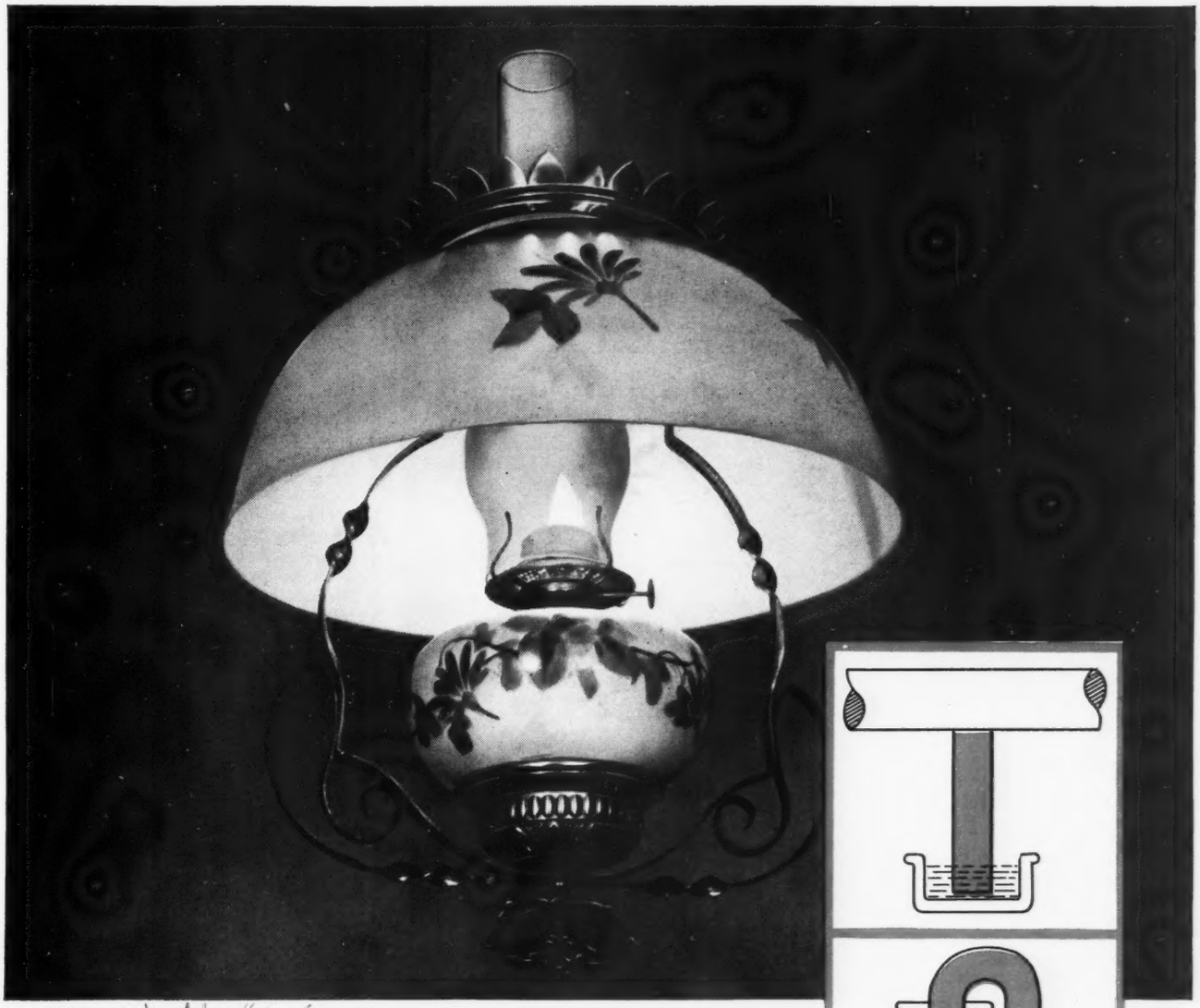

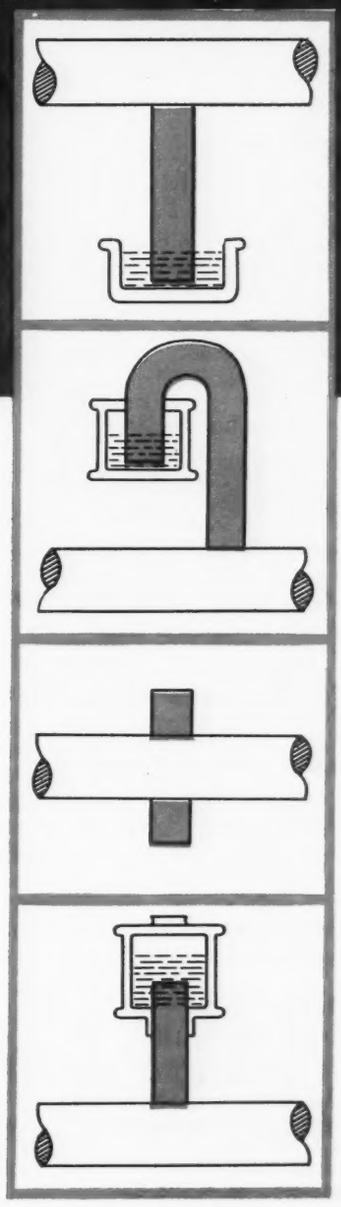

LIGHT from a lamp

Anyone who has ever used or seen a kerosene lamp or lantern knows how steady and clear the flame is, once the wick is correctly adjusted. The reason for this steady, smokeless and wasteless flame is that the wick feeds exactly the amount of oil required. Capillary action does the trick, plus correct wick type and adjustment.

Felt wicks can and do serve just as perfectly in lubrication. When correctly specified to meet the requirements of lubricant viscosity and delivery rate, they provide an accurately-metered quantity of oil to friction surfaces. It is not unusual for wick-lubricated bearings to serve without attention except at major overhauls; in other cases, re-filling of reservoirs at long intervals may be required. Felt wicks can be designed to deliver from a fraction of a drop per day, to many drops per hour; thus actual operating needs can be met. The basic source of wick lubrication technical data is American Felt Company's Data Sheet No. 6, "Wicks and Lubrication." Write for it today.

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Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Vanadium-Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

STEEL, Machine

Bethlehem Steel Co.
Crucible Steel Co. of America
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
Vanadium-Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

STEEL, Stainless

Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Ingersoll Steel Div., Borg-Warner Corp.
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
U. S. Steel Corp. (American Steel & Wire Co. Div., Carnegie-Illinois Steel Corp. Div.)
Wheelock, Lovejoy & Co., Inc.

STEEL, Strip and Sheet

Allegheny Ludlum Steel Corp.
Bethlehem Steel Co.
Republic Steel Corp.
Ryerson, Joseph T., & Son, Inc.
U. S. Steel Corp. (American Steel & Wire Co. Div., Carnegie-Illinois Steel Corp., Div., Columbia Steel Co. Div., Tennessee Coal, Iron & R. R. Co. Div.)
Ward Steel Co.

STEEL, Tool and Die

Allegheny Ludlum Steel Corp.
Carpenter Steel Co.
Republic Steel Corp.
Simonds Saw & Steel Co.
Vanadium-Alloys Steel Co.

STEEL, Zinc, Tin and Copper Coated Strip

Allegheny Ludlum Steel Corp.

STEEL ALLOYS

See Alloys, Steel.

STEEL BARS—See Bars, Steel.

STEEL STOCK GROUND FLAT

Brown & Sharpe Mfg. Co.
Starrett, The L. S., Co.

STELLITE

Haynes Stellite Co. (Alloy)

STOCKS, Die

Armstrong Bros. Tool Co.
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Standard Tool Co.
Threadwell Tap & Die Co.

STONES, Oil or Sharpening

Carborundum Co.
Norton Co.

STOOLS

Standard Pressed Steel Co.

STRAIGHT EDGES

Brown & Sharpe Mfg. Co.
Starrett, The L. S., Co.

STRAIGHTENERS, Flat Stock and Wire

Nilson, A. H., Mch. Co.
U. S. Tool Co., Inc.

STRAIGHTENING MACHINERY

Chambersburg Engineering Co.
Consolidated Mch. Tool Corp.
Elmes Engineering Div., American Steel Foundries
Hannifin Corp.
Hydropress, Inc.
Lake Erie Engineering Corp.
Morse Twist Drill & Mch. Co.
Oilgear Co.
Springfield Mch. Tool Co.

STUD SETTERS

Errington Mechanical Laboratory
Procunier Safety Chuck Co.

SUB-PRESSES

Baumbach, E. A., Mfg. Co.
Waltham Machine Works

SUPERFINISHING MACHINES

Gisholt Mch. Co.

SURFACE FINISH STANDARDS

Blake, Edward, Co.

SURFACE PLATES

See Plates, Surface.

SWAGING MACHINES

Cincinnati Shaper Co.
Hartford Special Machinery Co.
Torrington Co.

SWITCHES

Allen-Bradley Co.
General Electric Co.
National Acme Co.
Shepard Niles Crane & Hoist Corp.
Westinghouse Electric Corp.

TACHOMETERS

Bristol Co.
Leeds & Northrup Co.
Scherr, George, Co., Inc.
Veeder-Root Inc.

TAPE

Topflight Tape Co.

TAPER PINS, Standard

Morse Twist Drill & Mch. Co.
Pratt & Whitney

TAP HOLDERS

Errington Mechanical Laboratory
Gairing Tool Co.

TAPPING ATTACHMENTS AND DEVICES

Baker Brothers, Inc.
Brown & Sharpe Mfg. Co.
Errington Mechanical Laboratory
Jarvis, Charles L., Co.
Leland Gifford Co.
Procunier Safety Chuck Co.

TAPPING MACHINES

Baker Brothers, Inc.
Barnes Drill Co.
Barnes, W. F. & John, Co.
Baush Machine Tool Co.
Bodine Corp.
Buffalo Forge Co.
Cross Co.
Greenlee Bros. & Co.
Hartford Special Machinery Co.
Hill Acme Co.
Jarvis, Charles L., Co.
Kingsbury Mch. Tool Corp.
Leland-Gifford Co.
Moline Tool Co.
Murchey Div., Sheffield Corp.
National Acme Co.
National Automatic Tool Co.
Procunier Safety Chuck Co.
Warner & Swasey Co.

TAPPING MACHINES, Nut

Hill Acme Co.
National Machinery Co.

TAPS

Bath, John, Co., Inc.
Besly, Chas. H., & Co.
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Continental Tool Works Div.
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Murchey Div., Sheffield Corp.
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Standard Tool Co.
Sheffield Corp.
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TAPS, Collapsing

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Sheffield Corp.

THERMOMETERS, Indicating and Recording

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Landis Mch. Co.
Murchey Div., Sheffield Corp.
Pratt & Whitney
Taft-Peirce Mfg. Co.
Warner & Swasey Co.

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Fellows Gear Shaper Co.
Geometric Tool Co.
Hill Acme Co.
Landis Mch. Co.
Pratt & Whitney
Sheffield Corp.
Taft-Peirce Mfg. Co.

THREAD GAGES

See Gages, Thread.

THREAD GRINDING MACHINES

See Grinding Machines, Thread.

THREAD MILLING MACHINES

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Hanson-Whitney Mch. Co.
Murchey Div., Sheffield Corp.
Pratt & Whitney
Waltham Machine Works

THREAD ROLLING MACHINES

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Hill Acme Co.
National Machinery Co.
V & O Press Co., Div. Rockwell Mfg. Co.

TIN AND TERNE PLATES

Bethlehem Steel Co.
Republic Steel Corp.
U. S. Steel Corp. (Carnegie-Illinois Steel Corp. Div., Columbia Steel Co. Div., Tennessee Coal, Iron & R. R. Co. Div.)

TOOL BITS, High Speed Steel

Allegheny Ludlum Steel Corp.
Armstrong Bros. Tool Co.
Carpenter Steel Co.
Crucible Steel Co. of America
Everede Tool Co.
Ryerson, Joseph T., & Son, Inc.
Simonds Saw & Steel Co.
Vanadium-Alloys Steel Co.
Wheelock, Lovejoy & Co., Inc.

TOOL BITS, Special Alloy

Allegheny Ludlum Steel Corp.
Cleveland Twist Drill Co.
Everede Tool Co.
Haynes Stellite Co.
Kennametal, Inc.

TOOL GRINDERS

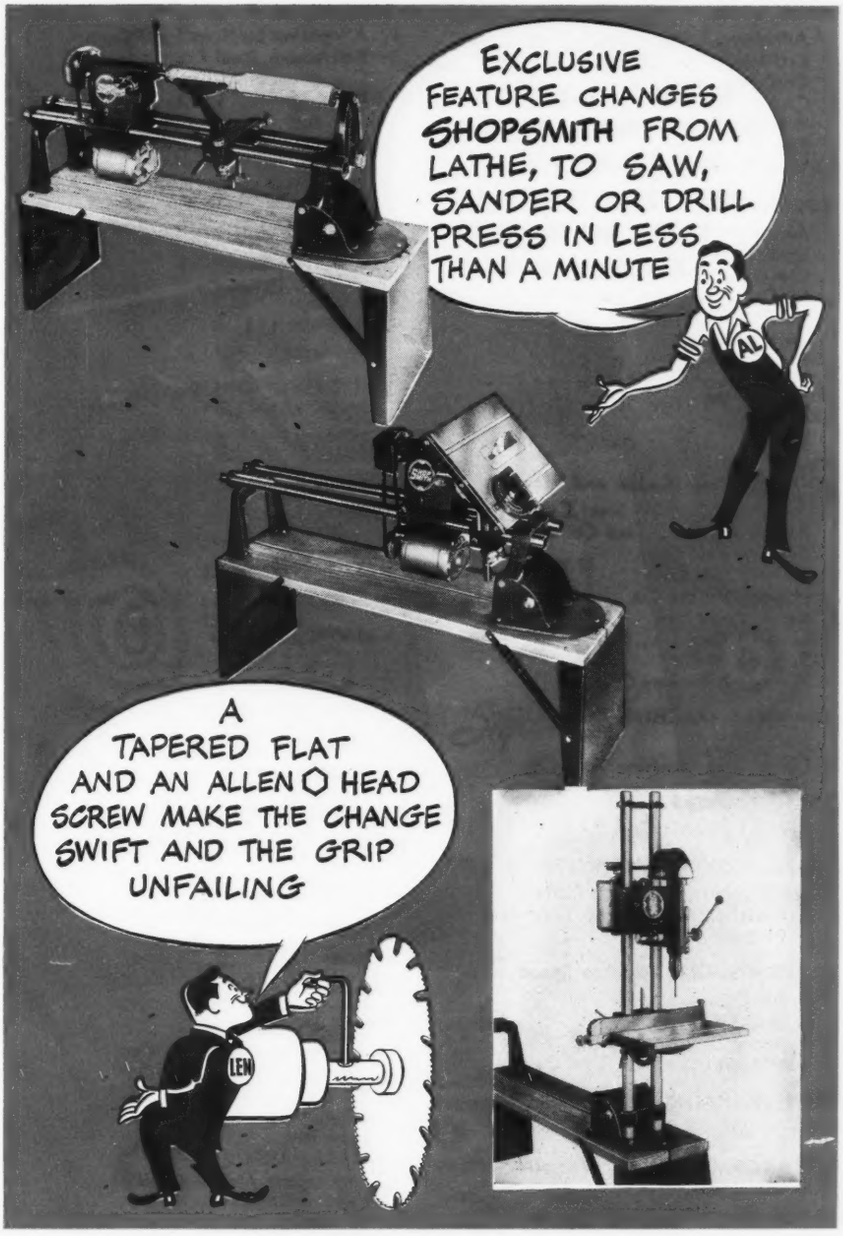
See Grinders for Sharpening Turning and Planing Tools.

TOOL HOLDERS

Armstrong Bros. Tool Co.
Blake, Edward, Co.
Everede Tool Co.
Gairing Tool Co.
Lovejoy Tool Co., Inc.
Michigan Tool Co.
R and L Tools
Warner & Swasey Co.

TOOLMAKERS' INSTRUMENTS

Ames, B. C., Co.
Brown & Sharpe Mfg. Co.
Scherr, George, Co., Inc.
Starrett, The L. S., Co.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Vanadium-Alloys Steel Co.

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Carboloy Co., Inc.
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Ex-Cell-O Corporation
Gairing Tool Co.
Kennametal, Inc.
Metal Carbides Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Super Tool Co.
Union Twist Drill Co.

TOOLS, Lathe, Shaper and Planer
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Armstrong Bros. Tool Co.
Everede Tool Co.
Gairing Tool Co.
Haynes Stellite Co.
Kennametal, Inc.
Lovejoy Tool Co., Inc.
Super Tool Co.
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TRANSMISSION MACHINERY
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American Metal Hose Branch, American Brass Co.
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TUBING, Steel
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Carpenter Steel Co.
Republic Steel Corp., Steel & Tubes Div.
Ryerson, Joseph T., & Son, Inc.
Timken Roller Bearing Co.
U. S. Steel Corp., National Tube Co., Div.
Van Huffel Tube Corp.

TUMBLING BARRELS
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TWIST DRILLS
See Drills, Twist.

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Root, B. M., Co.

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Raybestos-Manhattan, Inc., Manhattan Rubber Div.

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Philadelphia Gear Works (Motorized)

VALVES, Hydraulic
Barnes, John S., Corp.
Denison Engineering Co.
Elmes Engineering Div., American Steel Foundries
Hannifin Corp.
Hydropress, Inc.
Logansport Machine Co., Inc.
Oilgear Co.
Sundstrand Machine Tool Co.
Vickers, Inc.

VALVES, Pneumatic
Hannifin Corp.

VIBRATION INSULATION
American Felt Co.

VISES, Machine
Armstrong-Blum Mfg. Co.
Armstrong Bros. Tool Co.
Brown & Sharpe Mfg. Co.
Covel Mfg. Co.
Hannifin Corp.
Hendey Mch. Co.
Logansport Machine Co., Inc.
Producto Mch. Co.
Skinner Chuck Co.

VISES, Pipe
Armstrong Bros. Tool Co.

VISES, Planer and Shaper
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Cincinnati Shaper Co.
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Eaton Manufacturing Co., Reliance Div.

WASHERS, Spring
Eaton Manufacturing Co., Reliance Div.

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Air Reduction Sales Co.
Linde Air Products Co.

WELDING AND CUTTING GASES
Air Reduction Sales Co.
Linde Air Products Co.

WELDING EQUIPMENT, Electric Arc
Air Reduction Sales Co.
General Electric Co.
Lincoln Electric Co.
Westinghouse Electric Corp.

WELDING EQUIPMENT, Electric, Spot, Butt, Seam, Etc.
DoAll Co.

WELDING POSITIONER
Cullen-Friestedt Co.
du Mont Corp.

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Republic Steel Corp.
U. S. Steel Corp. (American Steel & Wire Co., Div., Columbia Steel Co. Div., Tennessee Coal, Iron & R. R. Co. Div.)

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Baird Machine Co.
Nilson, A. H., Mch. Co.

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Bliss, E. W., Co.
National Machinery Co.
Ryerson, Joseph T., & Son, Inc.

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Standard Tool Co.

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Armstrong Bros. Tool Co.

WRENCHES, Pipe
Armstrong Bros. Tool Co.

WRENCHES, Ratchet
Armstrong Bros. Tool Co.

WRENCHES, Tap
Butterfield Div., Union Twist Drill Co.
Card, S. W., Mfg. Co.
Greenfield Tap & Die Corp.
Morse Twist Drill & Machine Co.
Pratt & Whitney
Standard Tool Co.

WRENCHES, Torque Measuring
Armstrong Bros. Tool Co.
Elastic Stop Nut Corp. of America

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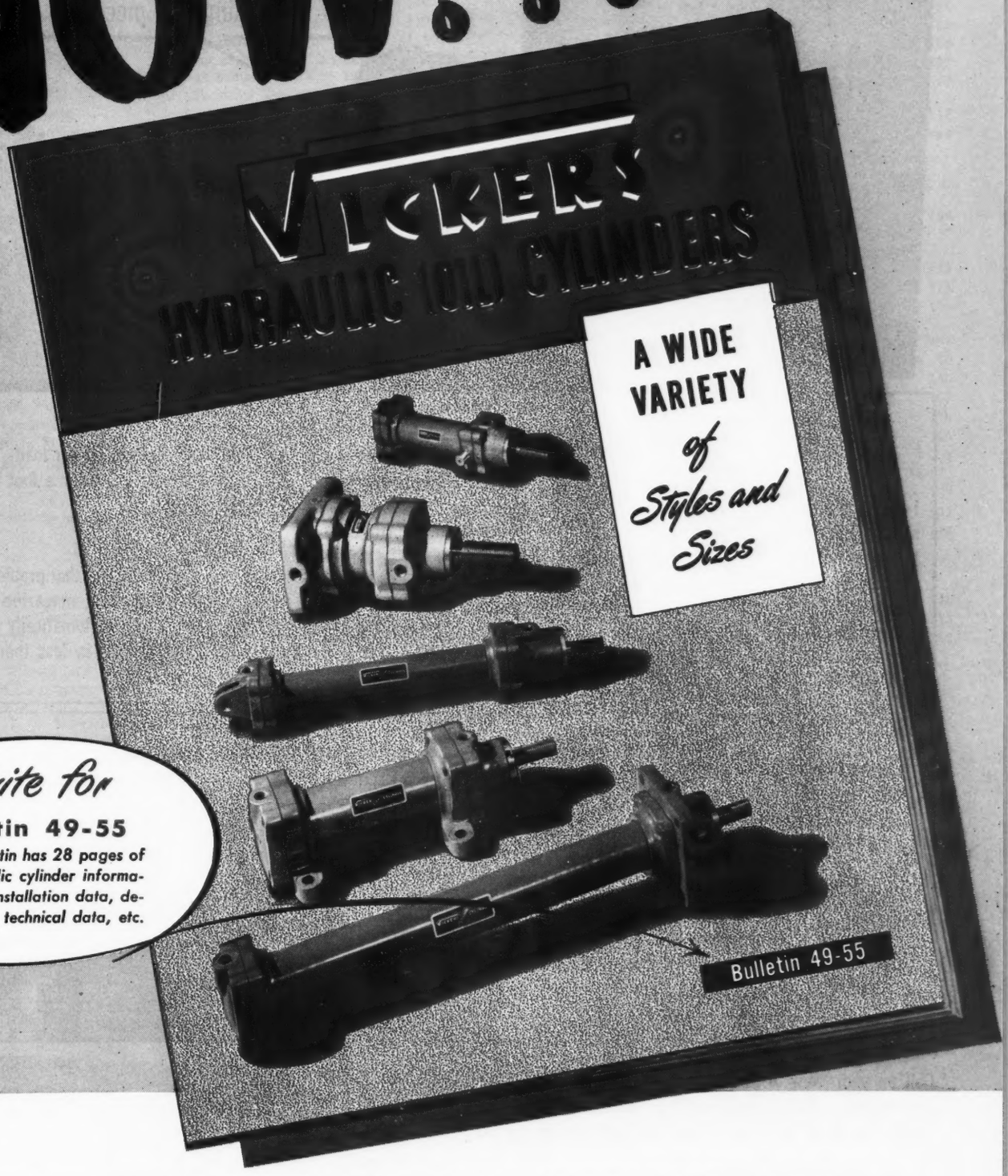

Write for

Bulletin 49-55

This new bulletin has 28 pages of useful hydraulic cylinder information such as installation data, design features, technical data, etc.

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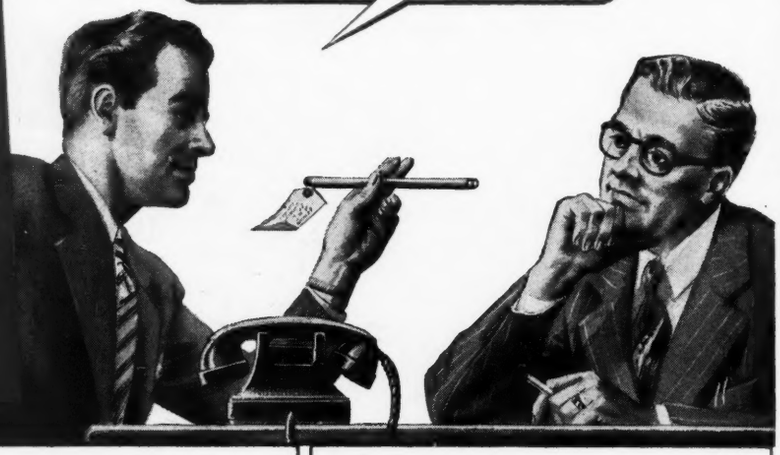
Said Mr. Hamilton* to Mr. Jones**

*Typical New Britain Sales Engineer
**Typical Industrial Executive

One New Britain 6 spindle automatic is replacing five machines in making this piece.



I only wish I could see my way clear to buy some new equipment. Some of my stuff's pretty old. What do they save on a job like that?

Well, first off they save operators. Then there's floor space and maintenance. Of course, you've got to consider the savings made on tooling and set-up of five machines against one. All in all they make the piece a lot cheaper on one automatic . . . and maintain the production rate and quality, too.

How much down-time for loading? That piece is over a foot long.

We licked that problem with an automatic, magazine-fed stock reel. It automatically loads all six spindles in less than a minute.

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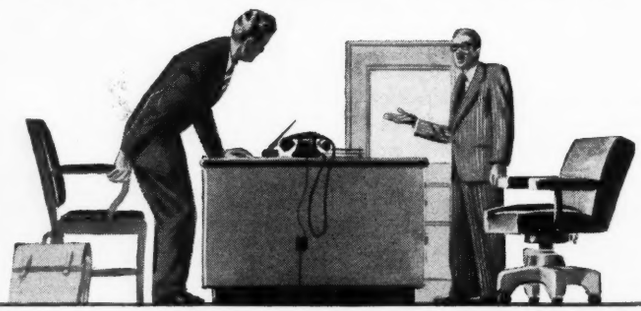
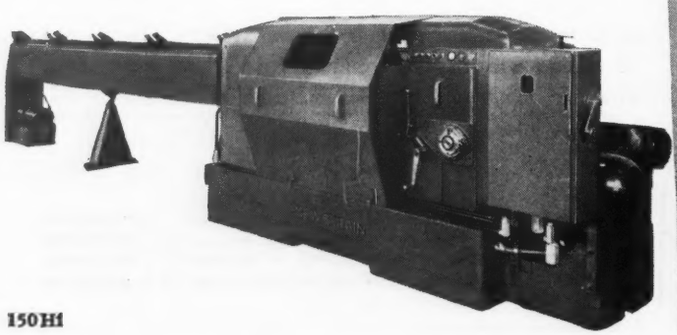
And we can't maintain the productivity we must have with over-age machines. This "modernize or die" business is no mere slogan!

What say we take a stroll through the shop right now. You might spot a job where we could save with automatic methods.



Call on your New Britain Sales Engineer to help you discover profit opportunities in metal cutting. Meanwhile, let us send you "It Can Be Done" with up-to-date cost histories on specific pieces.



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ALPHABETICAL INDEX OF ADVERTISERS

A

Abrasive Machine Tool Co. .. 309
Air Reduction Sales Co. 259
Ajax Manufacturing Co. 64
Allegheny Ludlum Steel Corp. 92
Allen Manufacturing Co. 363
Allied Products Corp. 264
Alltransport Incorporated 320
Aluminum Co. of America 294-295
American Brass Co. 285
American Broach & Mch. Co., Insert bet. 72-87
American Chain & Cable..... 283
American Felt Co. 361
American Hollow Boring Co.. 364
American Machine & Fdry. Co., Wahlstrom Tool Div.... 333
American Optical Co. 66
American Screw Co. 229
American Society of Tool Engineers 245
American Steel Foundries.... 69-121
American Tool Works Co..... 53
Arguto Oilless Bearing Co..... 319
Armstrong-Blum Mfg. Co. 300
Armstrong Bros. Tool Co. 288
Automotive Gear Works, Inc., Insert 63
Axelson Manufacturing Co. 344

B

Baird Machine Co. 304
Baker Brothers, Inc. 131
Barber-Colman Co., Insert bet. 72-87
Bardons & Oliver, Inc. 58
Barnes Drill Co.....Insert bet. 72-87
Barnes, John S., Corp. Insert bet. 72-87
Bath, John, Co., Inc. 65
Baumbach, E. A., Mfg. Co.... 305
Baush Machine Tool Co. 117
Beaver Gear Works Inc..... 314
Bennett Metal Treating Co.... 318
Besly, Charles H., & Co. 281
Bethlehem Steel Co. 100-103
Blake, Edward, Co. 309
Blanchard Machine Co. 50
Bliss, E. W., Company 243
Bodine Corporation 280
Botwinik Brothers of Mass., Inc. 322
Braun Gear Co. 314
Bridgeport Brass Co. 91
Bridgeport Machines, Inc 268
Bristol Co. 353
Brown & Sharpe Mfg. Co. 35-214-215
Buffalo Forge Co. 327
Bullard Company 40
Bunting Brass & Bronze Co.. 90
Butterfield Div., Union Twist Drill Co. 249

C

Campbell Machine Div., American Chain & Cable 283
Carboloy Co., Inc. 263
Carborundum Co. 126
Card, S. W., Mfg. Co. 357
Carlton Machine Tool Co..... 307
Carpenter Steel Co. 104
Chambersburg Engineering Co. 287
Chicago Perforating Co. 324
Chicago Pneumatic Tool Co. .. 62
Cimcool Div., Cincinnati Milling Machine Co. 29
Cincinnati Bickford Tool Co.. 219
Cincinnati Gear Co. 316
Cincinnati Milling Machine Co., Cincinnati Grinders Inc. 6-7
Cincinnati Shaper Co. 217
Cities Service Oil Co. 109
Classified Advertisements.. 322-323
Clausing Mfg. Co. 306
Clearing Machine Corp. Back Cover
Cleveland Crane & Engrg. Co. 118-119
Cleveland Punch & Shear Wks. Co. 274
Cleveland Twist Drill Co. 137
Cleveland Worm & Gear Co. Inside Back Cover
Climax Molybdenum Co. 342
Club Razor & Blade Mfg. Corp. 340
Colonial Broach Co. 224
Columbus Die, Tool & Machine Co. 320
Cone Automatic Machine Co., Inc. 27
Consolidated Machine Tool Corp. 125
Continental Tool Wks., Div. Ex-Cell-O Corp. 129-240
Covel Manufacturing Co. 330
Cross Company 234
Crucible Steel Co. of America 99
Cullen-Friestedt Co. 338
Cumberland Steel Co. 98
Cushman Chuck Co. 128

D

Danly Machine Specialties, Inc. 115-257
Davis Keyseater Co. 312
Davis & Thompson Co. 310
Dayton Rogers Mfg. Co. 304
De Laval Separator Co. 270
Delco Products, Div. General Motors Corp. 275
Denison Engineering Co. 266
Detroit Power Screwdriver Co. 312
Diefendorf Gear Corp. 316
DoAll Company 55
Doehler-Jarvis Corp. 105
du Mont Corp. 360

E

Earle Gear & Mch. Co. 318
Eastern Machine Screw Corp.. 364
Eastern Machinery Co. 322
Eastman Kodak Co. 313
Elmes Engrg. Div., American Steel Foundries 121
Ex-Cell-O Corporation 129-240

F

Fafnir Bearing Co. 269
Falk Machinery Co. 322
Farrel-Birmingham Co., Inc.... 341
Federal Bearings Co., Inc..... 302
Federal Products Corp. 278
Fellows Gear Shaper Co. 4-5
Felters Company 265
Ferracute Machine Co. 304
Fischer Machine Co. 312
Foote-Burt Company 56
Fosdick Machine Tool Co. 282

G

Gairing Tool Co. 347
Gallmeyer & Livingston Co.. 32
Ganschow Gear Co. 316
Gardner Machine Co. 258
General Electric Co. 16-17
Gisholt Machine Co., Insert bet. 42-47
Gleason Works 107
Gorham Tool Co. 340
Goss & DeLeeuw Machine Co. 306
Grant Mfg. & Machine Co. 304
Gray, G. A., Co. 267
Gray Machine Co. 304
Greaves Machine Tool Co. 311
Greenlee Bros. & Co., Insert bet. 72-87
Grob Brothers 308
Gulf Oil Corporation 49

H

Hannifin Corporation 24
Hanson-Whitney Machine Co. 25
Hardinge Brothers, Inc. 132
Hartford Special Mchry. Co.. 108
Heald Machine Co., Inside Front Cover
Hendey Machine Co. 122
Herbert, Alfred, Ltd. 321
Hill Acme Co. 110
Hyatt Bearings Div., General Motors Corp. 262

I

Industrial Machine & Gear Works 314
Industrial Press Insert bet. 288-293
Ingersoll Milling Machine Co., Insert bet. 72-87
Ingersoll Steel Div., Borg-Warner Corp. 95
International Nickel Co., Inc. 94

J

J & S Tool Co. 324
Jarvis, Chas. L., Co. 354
Johnson Bronze Co. 326
Johnson Manufacturing Co.... 308
Jones & Lamson Machine Co.. 59

K

Kearney & Trecker Corp.....20-21
Kennametal, Inc. 351
King Machine Tool Div., American Steel Foundries.... 69
Kingsbury Machine Tool Corp. 30-31
Kux Machine Co. 310

L

Laminated Shim Co., Inc..... 313
Lake Erie Engineering Corp. 252-253
Landis Machine Co. 2-3
Landis Tool Co. 10-11
La Placa Tool & Die Co. 318
Lapointe Machine Tool Co..... 343
LeBlond, R. K., Machine Tool Co. 60
Leeds & Northrup Co. 140
Leland-Gifford Co. 26
Lester-Phoenix, Inc. 276
Levin, Louis, & Son, Inc. 306
Lincoln Electric Co. 297
Lodge & Shipley Co. 112
Lovejoy Flexible Coupling Co. 316
Lovejoy Tool Co., Inc. 337
Lowe Bros. Co. 18-19
Lucas Machine Div., The New Britain Machine Co. 135
Luers, J. Milton 324

M

Madison-Kipp Corp. 106
Mahon, R. C., Co. 57
Manhattan Rubber Div., Raybestos-Manhattan, Inc.. 111
Massachusetts Gear & Tool Co. 314
Materials Section 87-106
Mattison Machine Works, Insert bet. 72-87
Metal Carbides Corp. 96
Michigan Tool Co. 230
Micromatic Hone Corp. 303
Miles Machinery Co. 323
Mitts & Merrill 311
Mohawk Tool Co. 356
Monarch Machine Tool Co. 54-120
Moore Special Tool Co., Inc.. 138
Morey Machinery Co., Inc..... 322
Morgan Engineering Co. 316
Morse Twist Drill & Machine Co. 254-255
Motch & Merryweather Mchry. Co. 48
Mummert-Dixon Co. 318
Murchey Machine & Tool Co. 237

N

National Acme Co. 39
National Automatic Tool Co., Inc. 68
National Broach & Machine Co. 51
National Erie Corp. 317
National Machinery Co. 116
National Twist Drill & Tool Co. 23
Newark Gear Cutting Mch. Co. 311
New Britain Machine Co., New Britain-Gridley Mch. Div.... 366
New Jersey Gear & Mfg. Co.. 314
New York State Dept. of Commerce 321
Niagara Machine & Tool Wks. 272-273
Nice Ball Bearing Co. 113
Nicholson File Co. 52
Nilson, A. H., Machine Co.... 134
Norton Company 14-15-261
Numberall Stamp & Tool Co.. 305

O

Oakite Products, Inc. 102
Ohio Crankshaft Co. 67
Oilgear Co. 251
Oliver Instrument Co. 359
O'Neil-Irwin Mfg. Co. 358
Orange Roller Bearing Co., Inc. 345
Ottemiller, William H., Co.... 304

P

Pangborn Corporation 368
Parker-Kalon Corp. 61
Pedrick Tool & Machine Co.. 305

Philadelphia Gear Wks., Inc... 315
Physicists Research Co. 335
Pittsburgh Plate Glass Co..... 324
Pope Machinery Corp. 271
Potter & Johnston Co. 37
Pratt & Whitney Div., Niles-Bement-Pond Co. 36
Procunier Safety Chuck Co..... 329

R

R and L Tools 114
Raybestos-Manhattan, Inc., Manhattan Rubber Div. 111
Reed-Prentice Corp. 248
Rehnberg-Jacobson Co., Insert bet. 72-87
Reliance Electric & Engrg. Co. 299
Republic Steel Corp. 88-89
Revere Copper & Brass Inc..... 247
Rockford Clutch Div., Borg-Warner Corp. 325
Rockford Machine Tool Co., Insert bet. 72-87
Rogers. Dayton, Mfg. Co. 304
Rowbottom Machine Co. 311
Ruthman Machinery Co. 319
Ryerson, Joseph T., & Son, Inc. 87

S

Sales Service Machine Tool Co. 331
Scherr, George, Co., Inc. 321
Seneca Falls Machine Co. 301
Sheffield Corporation 237
Sheldon Machine Co., Inc. 348
Shepard Niles Crane & Hoist Corp. 350
Shore Instrument & Mfg. Co., Inc. 324
Sibley Machine & Fdry. Corp. 349
Sier-Bath Gear & Pump Co., Inc. 318
Simmons Machine Tool Corp... 323
Simonds Abrasive Co. 277
Sinclair Refining Co. 70-71
S K F Industries, Inc. 136
South Bend Lathe Works 293
Stahl Gear & Machine Co. 318
Standard Gage Co., Inc. 42
Standard Oil Co. (Indiana) Insert bet. 32-35
Standard Pressed Steel Co...250-313
Standard Tool Co. 47
Starrett, L. S., Co. 238
Stokerunit Corporation 296
Stuart, D. A., Oil Co., Ltd..... 332
Sundstrand Machine Tool Co., Insert bet. 72-87
Sun Oil Co. 233
Super Tool Company 355

T

Taft-Peirce Mfg. Co. 38
Taylor & Fenn Co. 308
Texas Company 227
Threadwell Tap & Die Co..... 252
Timken Roller Bearing Co., Steel & Tube Div. 97
Topflight Tape Co. 340
Torrington Co. 133-334
Twin Disc Clutch Co. 284

U

U. S. Tool Company, Inc.....12-13
Union Drawn Steel Corp., Division Republic Steel Corp..88-89
Union Twist Drill Co. 260
United States Drill Head Co... 307
Universal Drafting Machine Corp. ..... Front Cover
Universal Engineering Co. 339
Used Machinery 322-323

V

V & O Press Co., Div. Rockwell Mfg. Co. 305
Van Huffel Tube Corp. 101
Van Keuren Co. 72
Van Norman Co. 8-9
Vanadium-Alloys Steel Co. 93
Verson Allsteel Press Co. 130
Victor Saw Works, Inc. 346
Vickers, Inc. 365
Viking Pump Co. 319

W

Wahlstrom Tool Div. American Machine & Fdry. Co..... 333
Waldes Kohinoor, Inc. 139
Wales-Strippit Corp. 298
Walker, O. S., Co., Inc. 328
Walker-Turner Div., Kearney & Trecker Corp. 286
Walls Sales Corp. 308
Waltham Machine Works 314
Warner & Swasey Co. 28
Wheelock, Lovejoy & Co., Inc. 336
Whiting Corporation, Insert bet. 220-223
Wilson, K. R. 279
Wilson Mechanical Instrument Co., Inc. 320
Winter Brothers Co. 22

Y

Yoder Company 41-127

Z

Zeh & Hahnemann Co. 304

IN CLASSIFIED SECTION

Botwinik Brothers of Mass., Inc. 322
Claeys, Leon 323
Eastern Machinery Co. 322
Falk Machinery Co. 322
Indianapolis Mchry. & Supply Co. 323
Miles Machinery Co. 323
Morey Machinery Co., Inc..... 322
Reid, Edward C., Co. 323
Simmons Machine Tool Corp... 323

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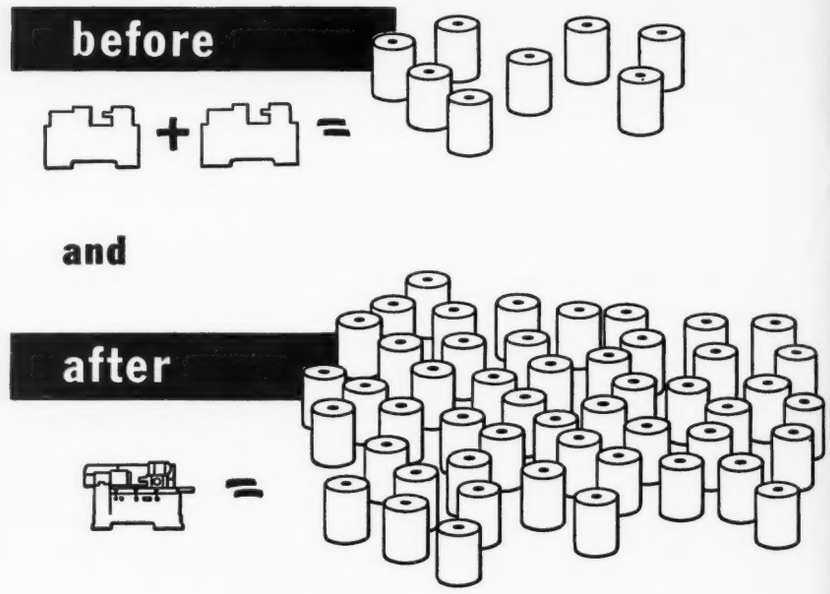
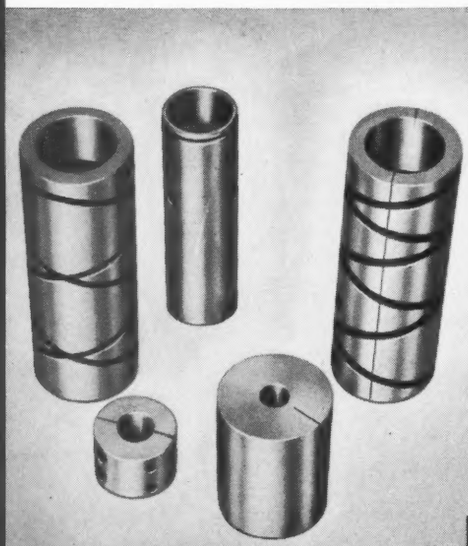


the installation of a New Heald Internal

In case you didn't count them, there are *fifty* cam rollers in the "after" picture—compared to eight "before." That's how much difference a New Heald Model 271 Size-Matic Internal Grinder was able to make in the production picture of a textile machinery manufacturer. Before this Heald machine went on the job, these cam rollers were finished on two older type grinders. Now one Model 271 turns out more than six times as many parts per hour!

This machine grinds a variety of textile cam rollers, to a tolerance of .0005" for size. In the case of one part, with a long bore, a damped quill is used to help eliminate the possibility of chatter and resultant unsatisfactory finish.

This is a typical example of how Heald engineering can help to step up production schedules and cut the cost of precision finishing operations.



These five different types of textile cam rollers are internally ground faster, and with greater precision, on the Heald Model 271 Size-Matic shown above.

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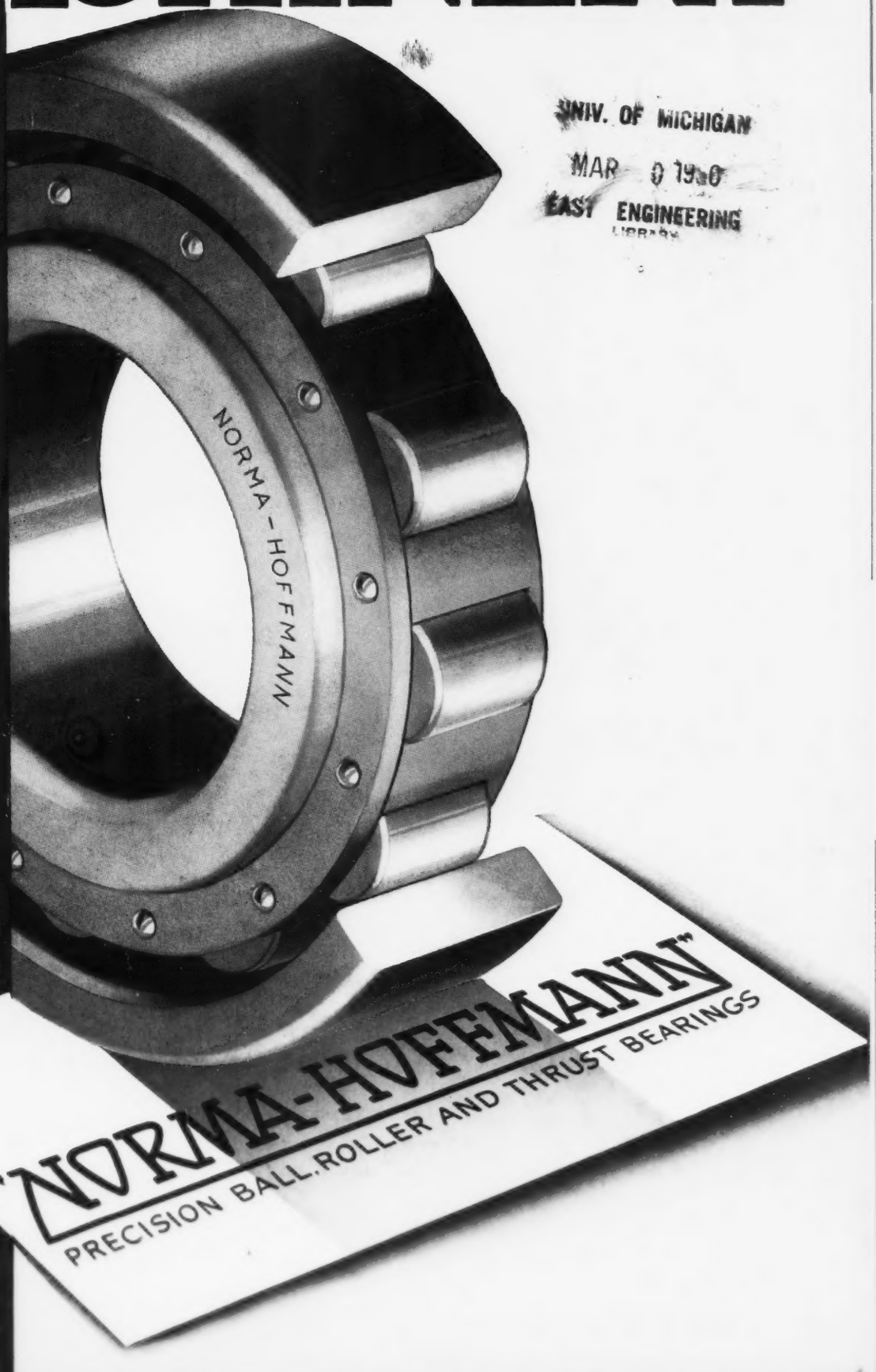
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